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THE ÆSTHETICS OF WATERFALLS.

At the recent British Association meeting Lord Kelvin said that he hoped the second generation of those present would be unable to see the Falls of Niagara, because in that day the whole power of the cataract should be utilized to drive machinery. He saw no reason why the present concessions for the development of nearly half a million horse-power should not be extended until the whole of the water passing the falls should be diverted through wheels, and Niagara, the cataract, cease to exist, being replaced by Niagara, the source of electrical energy.

The coldly utilitarian view thus expressed has created no little comment in various quarters, and has opened a very interesting question concerning the value of cataracts in general from the two standpoints of beauty and usefulness. There is a strong sentiment against marring this wonderful display of nature's forces with unsightly factories or bridling the mighty waters with the harness of industry. Many feel that it is a desecration of one of the most beautiful places in the world to spoil the landscape of Niagara with mills and put the water to the prosaic task of turning wheels. From a purely æsthetic point of view those ideas seem to possess much force, but the broad question of the greatest value of the cataract to all the people cannot be decided by reference only to the æsthetic side.

It is as painful in its way to the engineer to see the sad waste of several millions of horse-power at Niagara as it is to the purely sentimental person to contemplate the destruction of the falls for utilitarian purposes. It should be borne in mind, however, by those who look forward with regret to the day when there will be no more cataract, if such a day shall ever come, that the industrial developments which in that case will take its place will be even more beautiful. There is an element of beauty and majesty in the thunderous rush of vast volumes of water over the precipice at Niagara, but it is the beauty of waste and destruction. The enormous energy showered down from the sun over many thousand miles of land and sea and gathered in the waters of the upper lakes is here partially liberated—and entirely wasted. It furnishes a spectacle of incomparable grandeur, but at what cost?

Assuming the total power of Niagara to be 5,000,000 horse-power, and putting the value of this at the low figure of $10 a year, the annual waste amounts to the enormous total of $50,000,000—enough to pay interest on $1,000,000,000. Is the cataract, as a spectacle, worth this sum? Should not its energies be employed usefully in manufactures, adding to the general supply of wealth, and in this way enhancing the opportunities and bettering the condition of all the people of this country and Canada?

It may be a shock to the sensibilities of those in whose natures the æsthetic predominates to thus discuss the possible effacement of the spectacular cataract. But there is consolation even for these. The orderly activity of the mighty machinery which would be actuated by the great water power, and the harnessing of the elemental forces of nature in the service of mankind, would furnish a spectacle of even more impressive grandeur than that now displayed by the uncontrolled cataract.

THE BOSTON SUBWAY.

On another page will be found a full and elaborately illustrated description of the new subway for electric cars just opened in Boston. While this work has much interest as a somewhat remarkable piece of engineering, whose construction was accompanied with many difficulties, it possesses significance also in another way. Up to this time in America we have been content to use the surface of the streets for urban transit systems, except in the few places where crowded traffic and the necessities of high speeds have forced the railways into the air, as is the case in this city. It has been recognized almost from the first that the elevated railroad instead of being a real solution to the problem of municipal rapid transit was rather a makeshift whose existence must terminate whenever a better arrangement could be devised and carried out at a reasonable expense.

It is manifestly impossible to operate surface street railways at such speeds as to entitle them to consideration as means of real rapid transit. This is particularly true in cases where rapid transit is most urgently desired; that is, in crowded cities having large populations and generally large areas and distance to be covered by the railway lines. The elevated railway is in many respects as objectionable as the surface road. It has the sole advantage of being able to make better speeds, but it has also the corresponding disadvantage that it darkens the streets, fills the air with noises, and, in the case of steam-operated roads, with dirt and smoke. Under the ground is obviously the only place for a rapid transit system in a city, and the Boston subway is an excellent illustration of how an underground road should be built.

It is not unlikely that the success of the experiment in Boston will mean a great deal to railway systems and municipalities elsewhere, where the conditions are not dissimilar. The operation of an underground railway is made infinitely more easy and satisfactory by the use of electricity. The odors and gases from steam locomotives have been, up to the present time, argued as a reason against the construction of such subways, and the old underground system of London has been held up as a horrible example. This state of things has passed away. There is no reason why commodious, well-ventilated and cleanly tunnels should not take the place of the elevated railways which now disfigure New York, Brooklyn and Chicago, and some other cities, and equally no reason why cars now running on the surface and taking the chances of blockades from teams, accidents, damage suits due to negligent employees and the like, should not find the solution to many of their troubles in a subway in which high speeds could be maintained upon an absolutely private right of way.

DIRECT-CONNECTED MOTORS FOR MACHINE DRIVING.

For several years the application of electric power for the driving of individual machines has made slow but steady progress, until to-day electricity has come to be recognized as the most satisfactory agent for this purpose in the large majority of cases. The recent development of slow-speed motors adapted for direct-connection to driven machinery has had the effect of contributing most largely to this somewhat tardy recognition. It is likely that the advantages of motor-driving, now beginning to make themselves so distinctly manifest, will soon result in the disappearance of belts and shafting from a large percentage of progressive and well-regulated shops and factories.

The direct-connected type of motor possesses certain peculiar advantages of its own. It is needless to recapitulate the many obvious points of superiority of the electric motor over other forms of power-furnishing apparatus, since these are well known. Its general high efficiency, its remarkably close speed regulation and its great ease of control, all contribute to making it the most satisfactory agent for its purpose. The slow-speed motor, which can be applied directly to the shaft of the driven machine, has one other and great advantage not possessed by the separate motor, in that the loss in belt and gear transmission is obviated, space saved, and the simplicity of the combination enhanced.

The instantaneous control possible with electric motors and the absolute steadiness and smoothness of their motion render them ideal sources of power for many kinds of machinery. The fact that they will regulate inside of one revolution makes them especially applicable to machinery having reciprocating parts, such as printing presses.

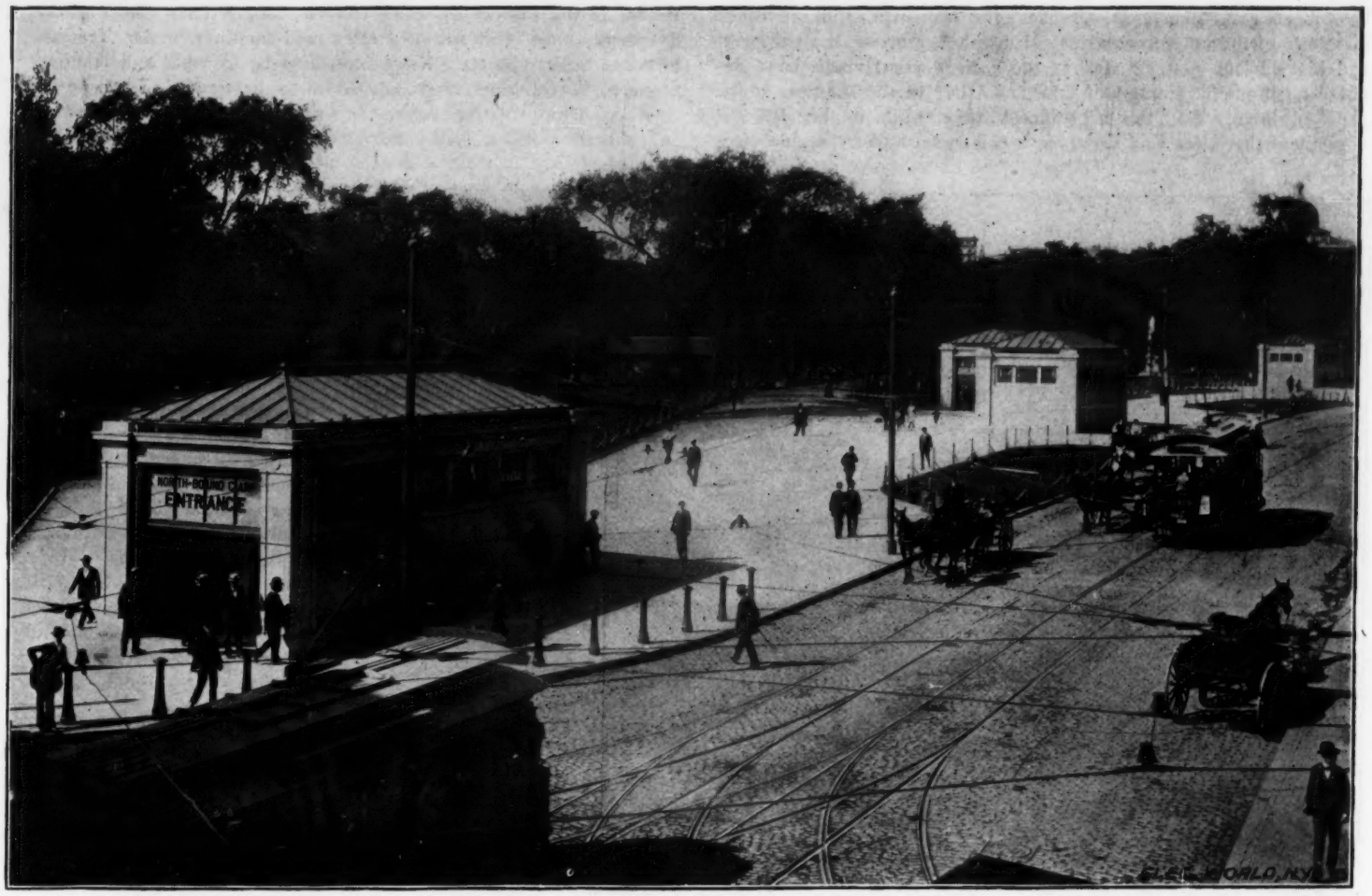
COMPRESSED AIR MOTOR TEST UNSATISFACTORY.

The air motor which has recently been tried on the Manhattan Elevated Railway in this city has been sent to the repair yards for a number of important changes, it having failed to make anything like the showing which its advocates claimed it would make. As is usual under such circumstances, the promoters of the compressed-air system claimed a number of minor mechanical causes for the failure of their locomotive, but the large and important fact remains that, after many years of experiment, and under the best conditions for success, the air motor has always been a failure.

If the directors of the Manhattan Elevated Railway have been waiting for demonstrations of the inefficiency of this method of traction before taking steps to equip their road with electricity, they should now feel satisfied. There has been no doubt in the minds of the engineering profession what the result of these trials would be, and it is to be hoped that this will be the end of the numerous experiments with strange systems of motive power for the New York elevated roads. There is no place in the country which exhibits such a crying need for electric traction as these railways. While it may be possible that the officers of the company will conclude to give the Keely motor a test before proceeding with the electrical equipment, it is certain that they have exhausted nearly every other variety of motive power, and that all the evidence that has been gathered has been in favor of the use of electricity. It seems strange in this day of progress that the elevated roads in this city should remain now in practically the same condition as they were at the time of their construction. It is not likely that their management can long resist arguments so potent as the increased capacity, decreased expense and superior earning power of the electrical system, added to the falling off of their business which the adoption of electric power on the surface roads paralleling them will certainly cause.

STANDARDIZING ELECTRIC GENERATORS.

In another column is a letter from Mr. Joseph E. Lockwood, on "Standardizing the Specifications for Electric Generators." The position taken by Mr. Lockwood is so eminently sensible that it must commend itself to all who are interested in this subject. His suggestion that the matter is one worth the attention of the American Institute of Electrical Engineers is very timely. At present the greatest confusion in the rating and classification of dynamos and motors is universal, and any steps that may be taken to remedy this condition of things and bring about substantial uniformity would be of the greatest value and importance.



ENTRANCE AND EXIT PAVILIONS ON THE TREMONT STREET MALL.

The Boston Subway.

BY J. E. TALBOT.

THE combination of problems in civil, mechanical and electrical engineering involved in the design and construction of this important work is unique in the history of the electrical industry.

There are, of course, instances of railroads—both horse, cable and electric—running underground for greater or less distances, of which the Baltimore tunnel electric system, the Park Avenue tunnel in New York, the tunnel under the Chicago River, the steam and electric underground systems in London, may serve as examples. In none of these, however, did the same conditions present themselves, as in the case of the relief of the crowded condition of the streets in the congested area of Boston.

It will be remembered by those familiar with the city that there are two main avenues of travel between the southern and northern portions, these being Washington Street, a narrow, tortuous and busy thoroughfare, and Tremont Street, with its extensions or branches of Court Street, Green Street, Sudbury Street, Hanover Street and Cornhill, leading to the North End and to the Northern Union Station.

For the purposes of the present article it would be useless to recapitulate the history of the agitation for the subway, and the various legislative hearings and enactments, resulting finally in the establishment of the Boston Transit Commission, the preparation of plans, the vigorous prosecution of the work, and the leasing of the subway to the West End Street Railway Company, which, as is well known, has the most extensive and best street railroad system operated by electricity in the world.

It is sufficient to say that after considerable public excitement and discussion the present route was decided upon, as under the circumstances the most satisfactory, work commencing in April, 1895.

The peculiar conditions confronting the engineers in charge of the undertaking were conflicting in their nature and difficult to reconcile.

It was not practicable to employ a low-level tunnel, transferring the passengers at the entrance to the tunnel and carrying them through to a terminus at the other extremity, for the reason that the main portion of the subway passes through the "shopping district," and it was a necessity to provide ready means of ingress and egress to the cars, without at the same time materially obstructing the surface of the streets, already too congested. This fact rendered it necessary to avoid or divert an inconceivably complex network of sewers, gas pipes, water pipes and underground electric conduits of various kinds, and to maintain their service without interruption or accident, and this, too, with as little disturbance as might be of the ordinary street traffic.

Some such disturbance has been unavoidable, but the public verdict is that it has been reduced to a minimum, to the credit of those having charge of this great undertaking.

It thus became essential to devise a system permitting the same cars, the same trolleys, and, practically, the same system of electric supply to be employed, to remove the service from the surface, and yet to allow of easy access from the street at various points to the underground system.

The subway itself, from the civil engineering standpoint, presents very many interesting features; portions of it are legitimate tunnel work, the form being elliptical, others are "cut and cover," with girders and brick arches, while in others special means have been devised by the engineers of the commission. To describe this portion of the work in detail is beyond the scope of the present article, its purpose being more especially to describe in some detail the electrical and cograte features of the work.

At the same time the illustrations furnish some idea of the difficulties encountered in avoiding obstructions, and also of the general nature of the undertaking and engineering construction.

The commission and its engineers are to be congratulated on the very satisfactory manner in which these unusual and novel difficulties

have been overcome. Mr. Crocker, the chairman, and the other members of the commission, Mr. Howard A. Carson, the engineer, and his efficient staff, as well as the various contractors, have devoted an immense amount of time and labor to the solution of the problems involved in this magnificent work, while in the electrical equipment the West End Company's engineers, under the able management of Mr. Sergeant and the direct supervision of Mr. Baker, master mechanic, have carried out their portion of the work in the first-class and thorough manner characterizing all their construction.

View at Park Street During Construction.

The general plan or scheme of the subway may be briefly described as that of a main artery or trunk line with four tracks running north and south, dividing at the southern extremity (Boylston and Tremont Streets) into two spurs or extensions, one running further south to the junction of Tremont Street with Shawmut Avenue, and the other tending somewhat to the west as far as the Public Garden, and at these termini emerging to the surface. In the other direction the work has only been fully completed as far as Park Street, where there is a station, and at which point the cars will return for the present in the subway by means of a loop. (See illustration). Eventually, however, subway traffic will continue under Tremont Street to Scollay Square, thence branching by Cornhill and Hanover Street to Washington Street, and so on to the terminus opposite the Northern Union Station, where the surface will be again reached.

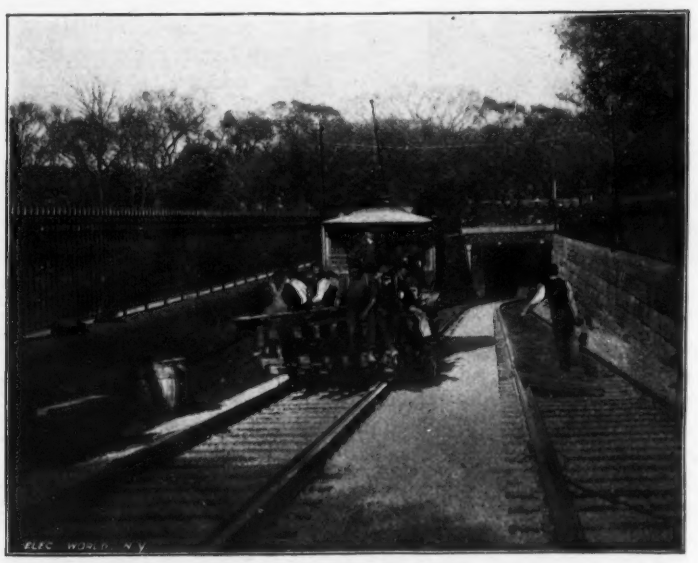
The main portion of the completed work passes under what is known as the Tremont Street Mall, which is, or was, a promenade or avenue forming one side of a part of Tremont Street, and also one side of Boston Common, while the spur running to the Public Garden passes along the old burying ground at the south side of the Common, running under Charles Street, and emerging at a point in the Public Garden nearly opposite the Thorndike Hotel on Boylston Street, by a moderate incline, protected by granite walls surmounted by an iron fence.

As an instance of the avoidance of cars crossing on the same level, it should be noted that at the corner of Boylston and Tremont Streets (hitherto a crowded and inconvenient centre of traffic) the Shawmut Avenue branch dives down by a considerable incline to a lower level, one track passing directly under the one running to the Public Garden.

Any possibility of collision or interference at crossings is thoroughly provided against, both by this means and by a very complete system of switches, while passengers desiring to pass from the northbound to the southbound track or vice versa must do so by an underground passage lined with white glazed brick and brilliantly lighted by incandescent lamps. The entrance to one of these is shown in one of the illustrations.

The platforms for the respective tracks are also divided by stout metal wire-work partitions, and it would appear that all liability to accident or mistake had been reduced to a minimum. Along each side of the subway runs a water main, having fire hose connected therewith at intervals of 250 feet, for the purpose of at once extinguishing any possible fire that may occur, and these are alternated on each side, so that only about 125 feet intervene between two fire-hose stations.

A Few Obstructions.



Construction Car—Public Garden.

On entering the subway through one of the granite, glass-roofed structures shown in the illustrations, the passenger descends an easy flight of about thirty steps, provided with brass hand-rails and safety-

treads, and on reaching the platform (of artificial stone), buys at the ticket office a check or ticket good for one fare to any point on the system of the West End Company reached by cars running into the subway, and with the usual privileges of transfer. This ticket is taken up by the car conductor and registered as a fare. The ticket offices are neat structures, provided with a gate admitting one person at a time, while at the exits turnstiles are placed for the purpose of the prevention of rushing and crowding, and of the entrance of the public except at the proper places.

The subway and its interior approaches are remarkably dry, light and clean, white glazed bricks and white paint enhancing the effects of the extremely efficient illumination furnished by the arc and incandescent lamps.

Very little moisture is apparent, though on damp, muggy days, no doubt, more or less condensation or "sweating" may be anticipated.

The foundation for the track is of broken rock ballast, similar to that used in regular steam railroad construction, and is laid to a depth of from 12 to 20 inches.

Upon this are laid chestnut ties 6½ feet long by 8 inches by 6½ inches, to which the rails are attached by spikes and a special form of tie-plate. The rails are of exceptional weight and solidity, 30 feet in length, and weighing 85 pounds to the yard, and, with the special guard-rail bolted to them, 128 pounds. The rail itself is the standard tee rail of the American Society of Civil Engineers. The electrical continuity of the track is provided for by two 0000 bonds at each joint.

The track is connected to the general system of return conductors of the West End system by heavy conductors, thus avoiding injury by electrolytic effects to gas or water mains, no return through the ground itself being used. In any general system of tracks extending over a large area it is manifestly impossible to prevent leakage to ground to some extent, if a difference of potential should exist, but here in the subway we have the unusual example of an appreciable insulation resistance as between the rails and the earth, amounting to some 40 ohms per 1000 feet.

The trolley wire is of the figure 8 form as designed by the West End Company, and has a cross-section equivalent to 360,000 circular mils. It is supported by an insulating fixture of special design from an overhead wooden trough or board of cypress, clamped to the roof ties or girders of the subway, and thoroughly insulated for the avoidance of grounds in the event of the trolley slipping from the conductor. This conductor weighs 1.064 pounds per foot, and is of such form as to suit the trolley wheels used by the West End Company.

Under the conditions obtaining in the subway, the rigidity of the overhead conductor was a matter of considerable importance, and it was also necessary to provide against the twisting of the figure 8-shaped wire. By the special hanger employed and the frequent intervals at which these are placed (12 feet apart, and on curves 6 feet), the object has been attained very satisfactorily.

The trolley wire within the subway is fed with current from feeders at both the Boylston Street and Park Street ends of the existing and operating underground system. When the whole system is completed, other feeding points will be established and the distribution of potential rebalanced.

The insulation resistance of the "overhead" system in the subway approximates 100,000 ohms, while the resistance per mile of the special trolley wire referred to is about 0.18 ohm.

For the lighting of the entrances, platforms, ticket offices and the subway itself, so far as relates to the portion already completed, seventy-five arc lamps and 600 incandescent lamps of 16 candle power each are employed, some 19 miles of wire having been used, as well as 2300 special forgings and cast-iron fixtures of forty-five different styles, as required for different locations.

One of the illustrations shows the appearance of the structures by which entrance and exit is had to and from the subway, and the glass roof and windows of the structure admit ample light during the day to the stairways, and a portion of the platform.

In such places at night, and where necessary during the day, arc lamps are used, connected five in series on the 500-volt circuit. These lamps are of the inclosed-arc type, some being "Manhattan" and some "Helios," burning 100 hours or more without retrimming. Of such lamps there are fifty-five, while, as an additional provision, twenty arc lamps of the usual form are employed, operated by current from the regular series high-potential circuits of the Boston Electric Light Company.

The incandescent lamps (16 candle power) are also operated five in series on the 500-volt circuit, and a criticism would naturally at first sight suggest itself that the extinction of one lamp involves the extinction of five lamps. Any material trouble from this cause is, however, obviated by the arrangement of the circuits. Three lines are run, lamps being taken off at intervals of 36 feet from each line. Therefore, there is a lamp every 12 feet, and the general illumination would thus be affected to a very slight degree by the absence of even five lamps, which in any case would only be temporary.

PUBLIC GARDEN ENTRANCE TO SUBWAY.

It is contemplated that ordinarily two of these lines will be supplied with current from the central power plant, and the other with current from the Dorchester power station, so that in the event of the opening of a circuit breaker in the central-power circuit or other cessation of current from that source, even then one-third of the lights will remain in operation. Inspection of this work shows that the arrangements for lighting have been carefully planned, and the result is entirely satisfactory, both on the platforms, where naturally the greatest amount of light is required, and also along the track.

The general appearance of this board is shown in the accompanying illustration.

As will be observed, it is a three-panel board, thus affording three distinct sources of supply of current. We may here explain that the West End system comprises one central power plant in Albany Street, and other subsidiary stations in the more or less remote suburbs, these supplying current to the outlying sections, or in case of breakdown feeding into other parts of the system.

One of the panels of the switchboard, therefore, is supplied from

The Loop at Park Street.

the central power plant; one is supplied from the Dorchester station, some 3 miles distant, and the third panel is connected to the 500-volt power circuit of the Boston Electric Light Company.

Under ordinary conditions, the two plants of the West End system can be drawn upon in such manner and at such times as desired. In the contingency of current not being available from one of these plants by reason of accident, repairs or otherwise, the whole load can be thrown upon the other source of supply, while in the more remote contingency of both those plants being disabled, the Boston Electric Light Company's current is on the third panel, and can be switched on instantaneousiy.

At the rear of this switchboard is another board, upon which are placed the fuses, with magnetic blow-out for each, and a single-pole switch for opening the circuit while replacing a fuse. Ample space is allowed for the connections between the boards and also all around them. The board is supplied with Weston ammeters, and electromagnetic circuit breakers of the General Electric form are used. The material and workmanship of the board are of the best (Grimshaw and Okonite wire being used), and reflect great credit on the staff designing and constructing the board.

For telephonic communication, both as between the various stations on the route and the other portions of the West End system, the arrangements are very complete. Bell telephones are used, and a 32-wire cable is carried on suitable insulators attached to fixtures supported on the angle-irons connecting the vertical and ceiling girders, on which, by means of specially designed fixtures, the bulk of the other wires are also carried.

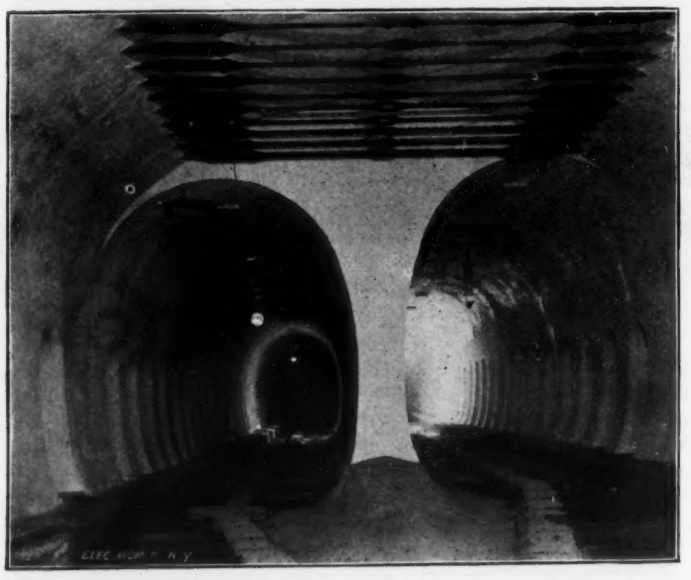
The telephone system will, of course, be extended to the other parts of the subway system when completed.

Beneath the tracks, covered by flagging and protected in the ballast, are drains for removing such water as may accumulate within the subway or be brought in by the cars or otherwise, and, for the removal of the discharge from these drains, pumps operated by electric motors are employed. In a pit receiving this drainage water is a float, rising and falling with the water; on reaching a certain height this float starts an electric motor automatically, which operates a rotary pump, this pump delivering the water to the sewer; in case of the first motor being from any cause disabled, a second one in reserve is brought into action, while, if it should so happen that this also is out of order, a signal is given (also automatically) to the man on duty in the switchboard room, notifying him that something is wrong.

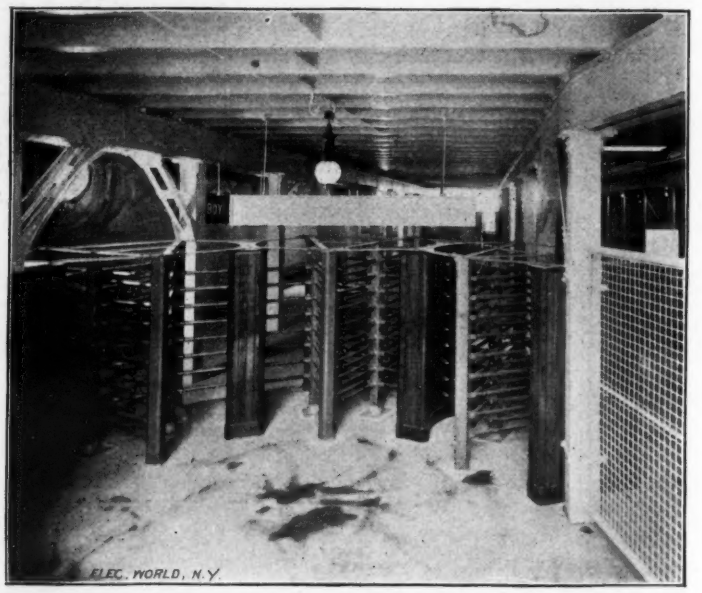
In one of the illustrations these drains are shown as they appear before the ballast is laid.

The pumps have a capacity of from 300 to 500 gallons of water per minute, and were made by the Lawrence Machine Company. They are directly connected to the shafts of the motors, which are of the General Electric multipolar form, rated, three at 5 horse-power each, and one at 10 horse-power.

The control of this motor-pump combination is effected by an arrangement similar to that used for starting and stopping electric elevator motors; the chain or rope attached to the float engages, by means of stops, with lever arms which either start the motor gradu-



Bellmouths during Construction.



Turnstiles at Boylston Street Exit.

ally by successively removing resistances from the motor circuit, or, to stop, open the circuit.

This device (the Moore Automatic Rheostat) is manufactured by the Moore & Wyman Elevator Works, South Boston. One of these pumping stations is located between Boylston Street and the Public Gardens, and the other in the Shawmut Avenue spur.

There is a certain amount of "seepage," or leakage of water into the subway from the surrounding soil, which was provided for in the construction of the side walls. At present this averages about 4 gallons per minute.

In times of heavy rain or snow considerable quantities of water may enter at the inclines and openings, but it is anticipated that the provision made will be ample to handle all accumulations with ease.

So far as appears at present but little necessity exists for artificial ventilation, the air being perfectly sweet and fresh. Provision is,

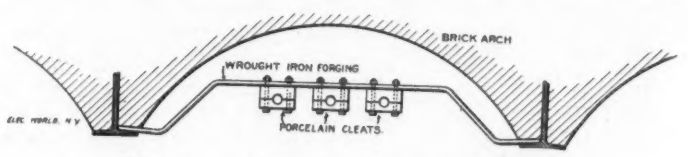
CROSSING UNDER TRACKS.

however, made at the various points for removing vitiated air, by means of large ventilating fans of some 8 feet in diameter, operated by electric motors connected to the 500-volt circuit, and belted to an extension of the shaft of the fan. These fans will exhaust air from the subway and deliver it into vertical wells or shafts communicating with the upper atmosphere.

The two ventilating pits in the present portion are placed, one in the Public Garden branch near the Boylston Street station, and the other about half-way between Boylston Street and Park Street, or nearly opposite West Street.

In connection with the new and unusual construction work in the electrical department, especially having regard to the high potentials used and the proximity to "ground" throughout the subway system, many new and ingenious devices have been developed by the engineering staff of the West End Company.

The waterproof lamp socket or holder is one of the most interesting of them. The socket proper has at the lamp end a closely-fitting spun-brass globe holder, while the wires conveying current to the lamp pass up through a small hollow brass casting, having a



METHOD OF ATTACHING INSULATING CLEATS.

downwardly projecting opening, through which the wires run out to the mains; between this casting and the flange or globe holder is a conical cap, the larger end of which fits the globe-holder, the smaller end being soldered to the casting after the wires are slipped through. The casting is attached to a fibre base, by which the whole device is screwed on to the fixture as illustrated.

The whole underground construction is, of course, brick, stone, or iron, and exceptional precautions are taken in the way of insulation and permanence and solidity of construction. No plugging of walls with wooden blocks is permitted; when a fixture is to be attached, if the support is an iron girder it is clamped on, or where supported by brick the work is cut away, the fixture inserted, and the hole cemented up. Various forms and shapes are used having reference to the form of the surface or point of attachment.

In conclusion, it may be said that so far as the experience of the past few days is any guide, the subway in Boston is a success, both in construction and operation. From the above description it will be apparent that the engineering and electrical construction is of the best, and the public is gratified with the smoothness of its working, the time saved and the relief afforded to surface travel, which is already evident.

Standardizing Electric Generators.

To the Editor of The Electrical World:

I have noted very frequently during the last year that consulting electrical engineers throughout the country seem to have each a different idea regarding the drawing of specifications for electric generators, some asking for efficiencies which are not practicable, others specifying a maximum rise of temperature above the temperature of the surrounding air, which necessitates the building of special machinery, in whole or in part, and as this tendency seems to, if anything, increase rather than diminish, it has occurred to the writer that it would be an extremely sensible and pertinent suggestion that the American Institute of Electrical Engineers, or some other suitable body of persons, take up this question, and, after obtaining from all interested parties their views as to what standard efficiencies, temperature limits, etc., as well as sizes of generators, should be adopted by all engineers throughout the country as standard, to then fix upon what seems to be the best for such standards, and thereafter, with the support of the electrical journals and the general trade, endeavor to get these standards specified by all engineers and others who may have need of same.

As you will undoubtedly remember, this course was followed by the National Electric Light Association when electric railway work first came into contact with electric light stations, the idea at that time being to adopt a uniform voltage for railway systems, and, as you know, it resulted in 500 volts being adopted and specified thereafter almost without exception, with the result that machinery very quickly became standardized, and many details and appliances were perfected which probably never would have been had all sorts of voltages from 300 to 700 been in use.

As no two manufacturers seem to be making dynamos of the same sizes, some making 5, 7½, 10, 15, 20, 30, 50, etc., while others may make 8. 12, 17½, 24, etc., it would be most desirable to have this question of sizes also investigated, so as to ascertain what sizes are most needed, and thus prevent the making of many sizes which are unnecessary, and by the adoption of standards make possible the manufacturing by different makers of machines of the same size, temperature, etc.

The foregoing you will undoubtedly find open to further suggestions and comments, but it will at least suggest the matter to you, and will, I hope, be found worthy of being advocated by THE ELECTRICAL WORLD.

JOSEPH E. LOCKWOOD.

Referring to the above letter, Prof. S. H. Short says:

"I certainly approve of a plan to standardize the specifications and sizes of electric generators, as proposed by Mr. Lockwood.

"We are constantly receiving specifications from various engineers throughout the country, which differ only slightly in output, speed and in temperature limits at full load, which necessitate more or less modifications in our standard machines to make them comply in all respects with the specifications referred to.

"I think that a full line of specifications could be established with the output, speed and temperature limits which would be in every way practical and satisfactory. We could then have our standard apparatus which would fill these requirements, thus enabling us to manufacture these machines and keep them in stock.

"By this method we could reduce the cost of manufacture materially, and give the benefit of the reduction to our customers. It would also enable us to figure the cost of a given plant very much more accurately than we can at the present time.

"I hope that you will make every effort to bring about the adoption of a standard line of machines in the same way that motors have been standardized."

Alternating Current Machinery.—XVI.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

POWER IN ALTERNATING CURRENT CIRCUITS.

136. In a simple continuous-current circuit of resistance r ohms, we know that the activity in the circuit, or the rate of expending electrical energy in it, may be expressed either in terms of E. M. F. and resistance, or in terms of current and resistance; or, finally, in terms of E. M. F. and current.

Thus, if e is the impressed E. M. F. in volts, the rate at which its source does work on the circuit is $\frac{e^2}{r}$ watts; or if g represents the conductance of the circuits in mhos $\left(\frac{1}{r}\text{ mhos}\right)$ this may be expressed as $e^2 g$ watts.

Again, if the current strength in the circuit is i amperes, the activity in the circuit is $i^2 r$ watts.

Finally, if e be the impressed E. M. F., and i the current, the activity in the circuit is $e i$ watts. If the direction of the current is

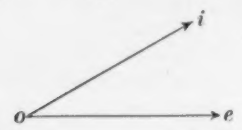


FIG. 88.—DIVERGENCE BETWEEN PRESSURE AND CURRENT IN A CONTINUOUS CURRENT SHEET.

FIG. 9.—RESOLUTION OF CURRENT INTO COMPONENTS.

opposite to that of some particular or local E. M. F. in the circuit, then work will be done by the current upon the source of this local E. M. F., and the activity so expended by the local E. M. F. is $-e i$ watts.

137. In practice it always happens that the current in a continuous-current circuit is either exactly in the same direction, or exactly in the opposite direction, to the E. M. Fs. acting in the circuit. In other words the angle contained between the directions of the E. M. Fs. and current is always either 0° or 180°. But the cases might occur, as, for example, when several circuits intersect in a conducting plate or in a conducting mass, where the current is not in line with the locally existing E. M. F. Thus in Fig. 88, let $o e$ represent in magnitude and direction a continuous E. M. F. e volts, locally acting at the point O of a conducting sheet in the plane of the paper. If $o i$ be, similarly, the magnitude and direction of the current flowing in the sheet at this point, then the activity of the source

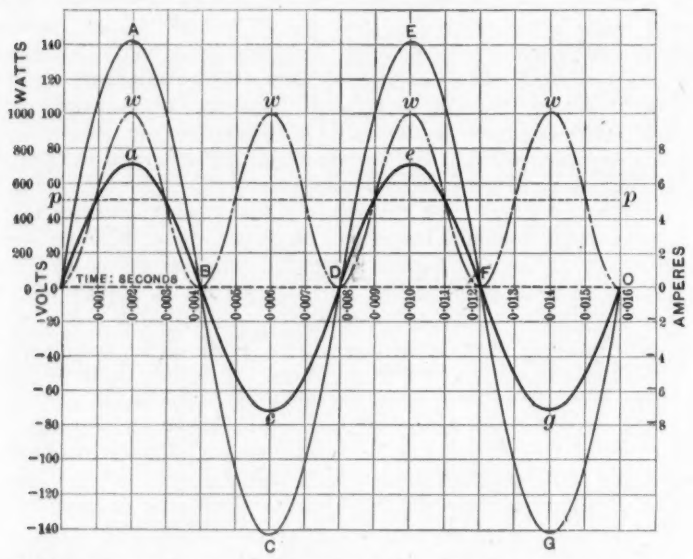


FIG. 90.—CURVES SHOWING ACTIVITY IN A SINUSOIDAL CURRENT CIRCUIT WITHOUT LAG.

of e, on the current, will not be $e i$ watts simply, but $e i \cos \alpha$ watts, where α is the angle included between e and i. For, considering Fig. 89, the current i may be resolved into two components, namely $i_1 = i \cos \alpha$ in the direction of e, and $i_2 = i \sin \alpha$ at right angles thereto. The product of e and its codirected component of current, or $e\,(i \cos \alpha)$ gives the activity of the E. M. F., since the pressure can do no work upon the component i_2 at right angles to its direction.

Strictly speaking, then, the activity in a continuous-current circuit of an E. M. F. e upon a current i, is their co-directed product, or $e i \cos \alpha$, but in practice this is abbreviated to $+ e i$, or $- e i$, according to whether α is 0° or 180°, and cos α is + 1 or − 1, accordingly.

138. The preceding rules find immediate application to the simple alternating-current circuit.

Let us first consider a reactanceless circuit. If the impressed E. M. F. is $E \sin \omega t$ volts, and the resistance is r ohms, the current strength will be $\frac{E}{r} \sin \omega t$ amperes. The effective E. M. F. will be $e = \frac{E}{\sqrt{2}}$, and the effective current $i = \frac{E}{r\sqrt{2}}$. The activity is obtained by multiplying the E. M. F., and current since both act in the same direction around the circuit. Consequently $P = E \sin \omega t \times \frac{E}{r} \sin^2 \omega t = \frac{E^2}{r} \sin^2 \omega t$, and this is known to be $e i + e i \sin \left(2 \omega t - \frac{\pi}{2}\right)$ watts.

The activity in the circuit may, therefore, be expressed as the sum of two terms. The first is the simple product $e i$ of the effective pressure and current; while the second is a sinusoidal or periodic term of amplitude $e i$, double frequency and $\frac{\pi}{2}$, or 90°, behind e in phase at time $t = o$, or at the starting time of the pressure.

139. This is illustrated in Fig. 90. Here we may suppose that an E. M. F. of 100 volts effective, or 141.4 volts amplitude, is constantly supplied at the secondary terminals of a transformer with a frequency of 125 ~ The faint curve $O A B C D E F G O$ represents this E. M. F. If the circuit is closed through an external inductanceless resistance of 20 ohms, the current strength will be 5 amperes effective, or a sinusoid of 7.07 amperes amplitude, coinciding in phase with the pressure, as shown, to the scale of amperes, by the heavy

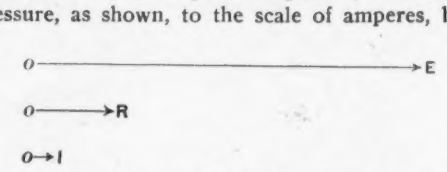


FIG. 91.—VECTOR DIAGRAM OF E. M. F., RESISTANCE AND CURRENT IN CASE OF FIG. 90.

curve $o a B c D e F g O$. If we multiply the corresponding ordinates of these curves, we obtain, to the scale of watts, the broken curve $o w B w D w F w O$, which is a curve of sine-squares. This is the activity in the external resistance, and it varies between 0 and 1000 watts twice in each cycle. The mean activity is represented by the dotted line pp at 500 watts. With reference to this line the activity curve is a sinusoid of double frequency, starting 90° behind the E. M. F. in phase.

The mean activity is therefore the product of the effective pressure (100 volts), and the effective current strength (5 amperes), or 500 watts.

140. The same case is also represented in the vector diagram of Fig. 91. Here $o E$ represents the E. M. F. of 100 volts at standard phase, $o R$ represents the external resistance of 20 ohms, parallel to $o E$, and $o I$ represents the vector quotient of $o E$ divided by $o R$, or 5 amperes at standard phase. Consequently $o I$ and $o E$ are parallel, and their numerical product is the activity of $o E$ upon $o I$. Since activity is not a directed quantity, but is what is called in contradistinction a *scalar*, or mere numerical, quantity, the activity product of $o E$ and $o I$ cannot be represented by a vector, but is a numeric.

141. We may next consider a circuit containing reactance and a consequent displacement in phase between the pressure and current. Suppose that while the E. M. F. is $E \sin \omega t$ volts, as before, the current is $I \sin (\omega t - \alpha)$ amperes, or lags behind the pressure by the angle α. If we multiply these together we obtain $P = E \sin \omega t \times \sin (\omega t - \alpha)$ watts, and this is known to be $P = e i \cos \alpha + e i \sin \left\{2 \omega t - \left(\frac{\pi}{2} + \alpha\right)\right\}$ watts.

Here, as in the reactanceless case, the activity is expressed as the sum of a constant quantity and a sinusoidal term of double frequency. On the average the latter is zero, so that the mean activity is $e i \cos \alpha$, or the product of pressure and current into their phase difference.

142. Fig. 92 represents the case of a circuit with positive reactance and current lag. The transformer of 100 volts secondary terminal pressure is here closed through an impedance of $20 \angle 60°$ ohms, or $10 + j\,17.32$ ohms (10 ohms resistance and 17.32 ohms reactance). The

current in the circuit is $\frac{100}{20\ /60^\circ} = 5\ /\overline{60^\circ}$ amperes represented by the heavy sinusoid $a\ b\ c\ d\ e\ f\ g$, which crosses the zero line positively 0.0133 second, or 60°, later than the faint sinusoid of pressure $o\ A\ B\ C\ D\ E\ F\ G$. Multiplying corresponding ordinates on these curves we obtain, to the scale adopted for watts, the broken line $w\ w\ w$. With reference to the mean line $p\ p$ of mean activity or

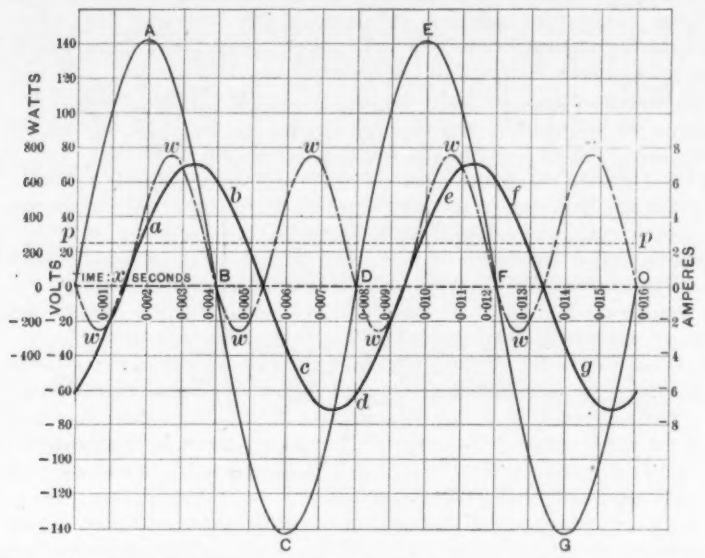


FIG. 92.—CURVES SHOWING ACTIVITY IN SINUSOIDAL CURRENT CIRCUIT HAVING 60° LAG.

power, this curve is a sinusoid of frequency 250 ~, lagging by 0.00167 second or 150° in its own cycle behind the pressure at the start. It is to be observed that for the first 0.00133 second in each alternation of pressure the activity is negative. This is evidently because during this part of the cycle the current and pressure are oppositely directed around the circuit. During these intervals the current is doing work upon the source of E. M. F., and the transformer has absorbed 0.22 watt-second (the area of the loop $o\ w\ x$), or 0.22 joule (0.164 foot-pound), of work from the circuit, which is, of course, more than returned by the transformer during the remainder of the alternation.

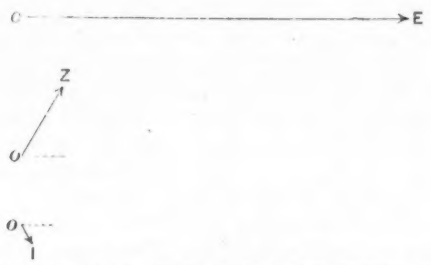


FIG. 93.—VECTOR DIAGRAM OF CASE REPRESENTED IN FIG. 92.

143. The vector diagram of this case is represented in Fig. 93. Here $o\ E$ is the pressure of 100 volts at standard phase, $o\ Z$ represents the impedance of $20\ /\overline{60^\circ}$ ohms, and $o\ I$ the current strength of $\frac{100}{20\ /60^\circ} = 5\ /\overline{60^\circ}$ amperes. The activity in the circuit is not the simple product of the lengths of $o\ E$ and $o\ I$, but their co-directed product, or $100 \times 5 \times \cos 60^\circ = 250$ watts. The divergence between the vectors of pressure and current makes them correspond in power relation to the case of divergent pressure and current in the continuous-current circuit, represented in Fig. 88. We may consider that the current $o\ I$ is resolved, as shown in Fig. 94, into two components namely $o\ i_1 = o\ I \cos 60^\circ$, in phase with the pressure $o\ E$, and $o\ i_2$, in quadrature with the pressure. The latter component receives no work from the pressure, and is therefore called the *wattless component*, while the former receives its full complement of work from the pressure, and is therefore called the *active component*. Or, considering the current as at standard phase the pressure $o\ E$ may be resolved, as in Fig. 95, into two components, one $o\ e_1 = o\ E \cos 60^\circ$, in phase with the current, and the other $o\ e_1 = o\ E \sin 60^\circ$, in quadrature with the current. The former component is called the *active component*, and the other the *reactive component*, with respect to the current $o\ I$.

144. The effect therefore of reactance and lag in an alternating watts, and to cause the activity to fluctuate not merely between a maximum and zero in each alternation of pressure, but between a current circuit is to reduce the activity from $e\ i$ watts to $e\ i \cos \alpha$ maximum and a negative quantity. In such a circuit $e\ i$ is called the

FIG. 94.—RESOLUTION OF LAGGING CURRENT INTO ACTIVE AND WATTLESS COMPONENTS.

apparent activity, while $e\ i \cos \alpha$ is the *real activity*, or the *true activity*. The ratio of the real activity to the apparent activity, or $\cos \alpha$ is called the *power factor* of the circuit. In other words, the apparent activity must be multiplied by the power factor to give the true activity. The power factor is always less than unity. In some cases it may be a small fraction, say 0.1, as in the case of a coreless coil of low resistance and high inductance; but in commercial alter-

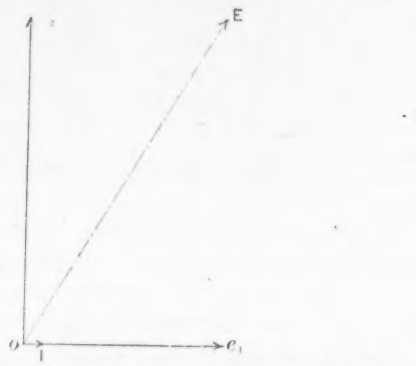


FIG. 95.—RESOLUTION OF LEADING PRESSURE INTO ACTIVE AND REACTIVE COMPONENTS.

nating-current circuits employing *ferric inductances*; *i. e.*, inductances linked with iron cores, the power factor is usually greater than 0.5.

145. Similar considerations apply to the case of a circuit containing negative reactance or condensance, with resulting positive-phase difference, or leading current. Fig. 96 represents the action of the transformer previously considered, supplying 100 volts secondary terminal pressure to an impedance of $20\ /\overline{60^\circ}$ ohms, or $10 - j\ 17.32$ ohms., such as might be obtained with a condenser of 73.5 microfarads capacity in series with a resistance of 10 ohms. Here the current in the circuit

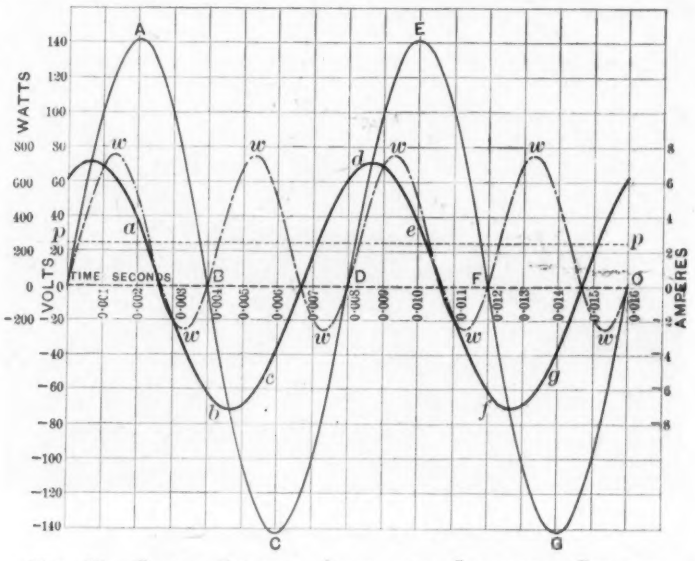


FIG. 96.—CURVES SHOWING ACTIVITY IN SINUSOIDAL CURRENT CIRCUIT HAVING 60° LEAD.

is $\frac{100}{20\ /60^\circ} = 5\ /\underline{60^\circ}$ amperes, as represented by the heavy curve $a\ b\ c\ d\ e\ f\ g$, leading the faint pressure curve $A\ B\ C\ D\ E\ F\ G$ by 0.00133 second, or 60°. If we multiply corresponding ordinates on these curves we obtain the broken line of activity $w\ w\ w\ w$, which is the same curve as the activity curve of Fig. 92 for a circuit of 60° lag, except that it is advanced in time by 0.00167 second. It may be represented as the sum of a mean power, indicated by the horizontal

line $p\,p$ of 250 watts, and a periodic term, which is zero on the average; namely, $e\,i \sin\left\{2\,\omega\,t - \left(\frac{\pi}{2} - \alpha\right)\right\}$ a sinusoid of double frequency and lagging behind the pressure at the start by the complement of the angle α. The vector diagram in this case is the same as that represented in Figs 93 and 94, except that the angles are reversed.

146. The preceding rules apply not merely to strictly sinusoidal currents, but also to currents in any alternating-current circuit. When the ammeter on an alternating-current circuit, say a high-pressure feeder at a central station, indicates 20 amperes, and the pressure is shown by voltmeter to be 2000 volts, the real activity of the circuit, assuming that the instruments are properly calibrated, cannot be greater than 40,000 watts, and is usually less than this apparent activity. If we know the power factor of the circuit, or what corresponds to cos α in a sinusoidal-current circuit, the product of this power factor and 40,000, will give the real mean power electrically delivered to the feeder. This power factor will commonly vary between 0.7 and 0.95.

147. If the current strength in a sinusoidal-current circuit is i amperes and the resistance is r ohms, the mean activity is always $P = i_2\,r$ watts. Thus in the case represented in Figs. 92 and 93 $i = 5$ and $r = 10$. Consequently $P = 5 \times 5 \times 10 = 250$ watts. This is the same rule as for a continuous-current circuit.

148. If the impressed E. M. F. in a sinusoidal-current circuit is e volts, and the conductance of the circuit is g mhos, the activity in the circuit is $e^2\,g$ watts. Thus, in the case of Figs. 92 and 93 the impedance $Z = 20 \angle 60°$ ohms, so that the admittance is $Y = 0.05 \angle 60°$ mho $= 0.025 - j\,0.433$ mho Consequently the inductance is 0.025 mho, $e = 100$. Thus $P = 100 \times 100 \times 0.025 = 250$ watts. This is the same rule as for a continuous-current circuit.

Property of the Nassau Railway Company Burned.

Shortly before 4 o'clock on the morning of September 3 a fire started in the machine shop of the Nassau Electric Railway Company, at Thirty-sixth Street and Church Avenue, Brooklyn. Adjoining the shop were three other buildings used for car storage purposes, and for the construction of cars which the Nassau Company built for its own uses. The buildings are separated by 16-inch brick walls, intended to act as fire barriers, but the fire consumed all four, with the machinery, the stock and eighteen cars, which were stored in the car barns. The paint shop, which adjoined the other buildings, fortunately escaped. The total loss is estimated at about $75,000. Work was begun the day following the fire in removing the rubbish, and new buildings will be constructed at once.

Wrecked Car Barns—Front View.

The iron work from the twelve roof trusses, as it lies piled along the tracks near the shops, resembles, more than anything else, a lot of ribbon, or ticker tape, which has been blown into all manner of fantastic shapes by a strong breeze. In the shops nineteen cars were burned, three or four of which were new, having just been built. A pile of upward of 200 armatures, piled in what was the armature room, will be almost a total loss. The commutators are badly sprung, and many of the shafts are out of true. The armature cores are probably all right, and some of the shafts can perhaps be trued up when they come to be examined closely.

The Thomson Meter.

To the Editor of The Electrical World:

Sir—In your issue of August 28 there appears the first installment of a paper by Mr. Ricks, describing tests made in my laboratory on various electric supply meters. From the results there given it would appear that the Elihu Thomson energy meter (or so-called "Recording Wattmeter"), when used at ordinary temperatures, reads about 13 per cent. too low at one-tenth full load, and that, when measuring ordinary direct-current loads, an increase of temperature of 39° C. raises the speed of the meter by about 11 per cent.

I have no reason to doubt the accuracy of Mr. Ricks' results. Indeed, the very careful and painstaking way in which he carried out the investigation described in his paper leads me to think it highly probable that the figures and curves which he publishes do really record the behavior of the meters which he tested. But, during my recent visits to the works of the General Electric Company, at Schenectady, and at Lynn, I have been convinced that the particular meter which was lent Mr. Ricks by the British Thomson-Houston Company for testing cannot be regarded as a sample of the instruments which are now being manufactured in large quantities there.

From his tests of the Thomson meter Mr. Ricks states it may, therefore, be surmised that the coefficient ("of change of resistance with temperature") of the pressure coil is very much less than that of the copper disc. To construct an energy meter with this difference in the temperature coefficients is, of course, quite wrong, scientifically; and Prof. Elihu Thomson tells me that in his instructions he has emphasized the fact that the temperature coefficient of the pressure circuit should be equal to that of the copper pressure disc. As a proof that this condition is really fulfilled in the Thomson meters constructed in the United States various curves have been shown me, from which it appears that, at ordinary loads, a change of 40° C. in the temperature of the meter alters the constant only 3½ per cent., instead of by the 11 per cent. found by Mr. Ricks.

Further, I have watched tests being made on one of these meters at Lynn at temperatures of 65° C. and at 24° C. The meter in question was a 50-volt, 15-ampere meter, and, when tested at 52 volts and 11.75 amperes (that is, at about three-quarters of full load), there was only 1 per cent. difference between the results obtained at these two temperatures, although they differed by 41° C.

Next, as regards the difference between the value of the constant of this type of meter at low and high loads, it would appear from the curves which have been shown me recording the results of various tests that with some specimens there is practically no appreciable difference in the value of the constant anywhere between full load and one-twentieth full load, while with other specimens the constant is about 2 per cent. higher at one-tenth of full load than at full load. These are very different results from those obtained by Mr. Ricks with the meter lent him for testing, for he found that the constant at full load had to be increased by 19 per cent. to make the meter read correctly at one-twentieth of full load.

Some hurried tests at various loads were made in my presence here, of the meter already referred to. The results at low loads were not very satisfactory, as the meter armature turns very slowly, of course, at small loads; and time-pressed, as the factory was, on the point of being closed for three days. Hence, we had to content ourselves with timing one revolution only of the armature instead of waiting to take many, as was done in the very much more accurate tests carried out by Mr. Ricks. But it seemed clear that the variation of the constant between full and *one-thirtieth* of full load was not as large as was found by Mr. Ricks between full and *one-twentieth* of full load.

Hence, I conclude, both from the curves of previous tests, as well as from the tests which I saw carried out, that the Elihu Thomson meter tested by Mr. Ricks had not merely a much higher temperature coefficient than meters constructed at Lynn, but possessed a greater frictional resistance, or had "an initial energy coil," which was not powerful enough. Very truly yours,

W. E. Ayrton.

Lynn, Mass.

American Electrical Machinery Abroad.

Electrical exports from this country are steadily increasing. One large company, with its factory in the Central States, reports recent orders for sixteen complete street railway equipments, and fully 16,000 horse-power in railway motors, besides orders for lighting machinery and railway generators.

Some Tests on the Variation of the Constants of Electricity Supply Meters with Temperature and with Current.—II.

BY G. W. DONALD RICKS.

SCHUCKERT METER.

This meter is exactly the same in principle as the Elihu Thomson meter, and is very similar to it in construction. It consists essentially of a small electrometer in which no iron is used, and whose motion is retarded by Foucault current friction. In Fig. 5, A is the armature, wound with fine wire, and having in series with it a high resistance, part of which is wound to give a permanent driving torque, the remainder R being wound non-inductively. The field is produced by the main current in the series coil C_1 C_2, and the retarding torque is obtained by the action of the permanent

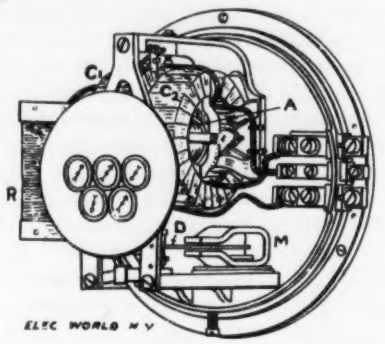
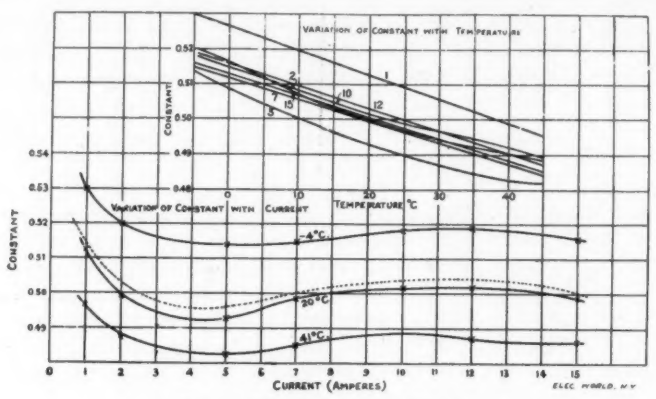


FIG. 5.

magnets M on the copper brake disc D. The equation of motion of this meter is, of course, identical with that of the Elihu Thomson meter. Referring to this sheet, it will be seen that the constant there is equally applicable to the Schuckert meter.

The curves on Sheet II. show the results of the tests on this meter. Referring to this sheet, it will be seen that the constant, after starting, as the current is increased, rapidly approaches its



CURVE II.—SHUCKERT METER.

declared value, falling below it at about 15 per cent. of the maximum current. The curve then dips down, but rising again crosses the declared value at about 50 per cent. of maximum current, after which it remains fairly constant till near the maximum, when it decreases slightly. The high value at low current is, of course, due to the uncompensated solid friction, but the reason for the shape of the remaining part of the curve is not apparent.

The effect of temperature is also shown on Sheet II.; the mean temperature co-efficient is about 0.13 per cent. per °C. This is much lower than the co-efficient of the Thomson meter, and may possibly be due to a larger co-efficient in the pressure circuit. It will be seen from Table II. that varying the pressure has no appreciable effect on the accuracy of the meter.

The starting current was found to be rather high, being 0.29 ampere, or 1.93 per cent. of the maximum. The absorption of power is also very considerable, being 14.7 watts at maximum load, and 4.8 watts at no load. The fall of potential in the series coils is 0.66 per cent.

The general characteristics of this meter are much the same as those of the Thomson meter. The constant approaches its normal value at a much lower percentage current, but, on the other hand, the remaining part of the curve is less regular.

FERRANTI METER.

The action of this meter is dependent on the principle that when a current is passed radially through a fluid which is in a perpendicular magnetic field, the fluid tends to move in a direction at right angles to the directions of both the current and the field.

A diagram of its construction is shown in Fig. 6, where T is a disc-shaped insulated chamber, containing mercury. It is made of vulcanized fibre, and is fixed to the magnet pole M_2, the other pole M_1 being close above it. The electromagnet is energized by the main current in the coil e, and is so designed that only the com-

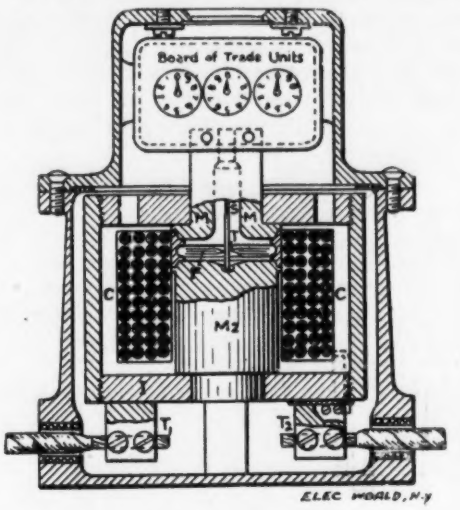


FIG. 6.

paratively straight part of the magnetization curve is employed—that is, the magnetic field is very nearly proportional to the main current. The current enters the meter at the terminal T_1, which is connected with the iron case I, it passes up M_2, and enters the mercury at the central part T, and flowing radially outward enters the coil e by means of a metal rim, and then leaves the meter by the insulated terminal T_2.

The chief retarding force is that due to fluid friction of the mercury against the sides of its chamber, which are stamped with radial grooves to increase the effect and make it proportional to the square of the speed over as large a range as possible. The counting mechanism introduces a small amount of solid friction, which is practically constant and is compensated for by using mild steel for the magnet core, which then has a small amount of permanent residual magnetism. The motion of the mercury is transmitted to a very delicately made counting mechanism by means of a vane immersed in it, and having a small vertical spindle which gears into the counting mechanism. Very pure mercury is used and the spindle is of very small section at the part where it breaks the surface, so that skin friction is not very great.

The law of the meter may be expressed thus, assuming, however, that the fluid friction is proportional to the square of the speed throughout the whole range:

Variation of constants.

Let A = main current.
M_A = magnetization due to the current A.
M_R = residual magnetization.
w = angular speed of the armature.
qw^2 = force due to fluid friction.
p = force due to solid friction.
k = a constant.

Then $kA(M_A + M_R)$ = total driving force.
and $p + qw^2$ = total retarding force.

For steady motion

$$kA(M_A + M_R) = p + qw^2.$$

Assuming magnetization proportional to the current

$$M_A = bA,$$

and residual magnetization constant

$$M_R = r,$$

Then

$$kA(bA + r) = p + qw^2,$$
$$kbA^2 = qw^2 + p - kAr.$$

If the retarding force due to solid friction is exactly neutralized by the driving force due to residual magnetism,

$$p = kAr,$$

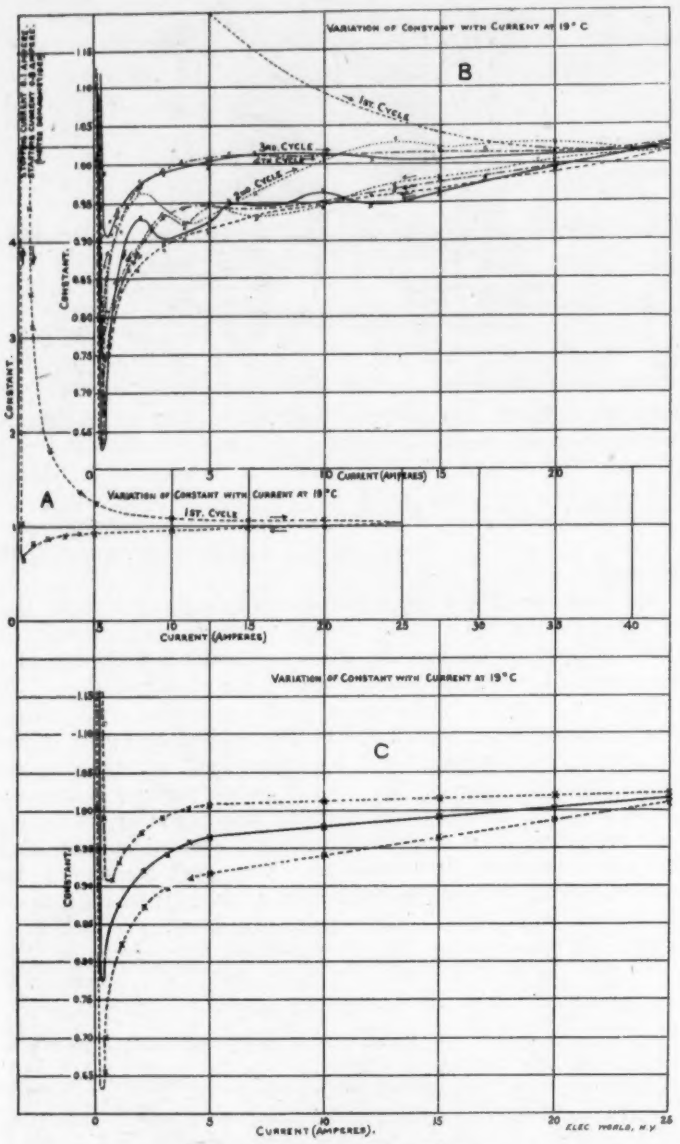
and

$$A^2 = \frac{q}{kb} w^2.$$

That is, the speed is proportional to the current.

This meter is made up in an extremely compact form, and has the great advantage of simplicity of construction. The substitution of residual magnetism for that produced by shunt windings used in an earlier pattern, has removed one of its principal drawbacks, the waste of energy in the shunt. It possesses, however, the disadvantages attendant upon comparatively small driving and brake forces, necessitating the employment of an extremely light and frictionless counting mechanism, which, owing to its very delicate construction, must require very careful handling. It is also essential that the mercury used should be of the highest degree of purity, for the law of the meter depends directly on its viscosity, which would be seriously affected by impurities even in small quantity.

The tests on this meter revealed several characteristic points not found in any of the other meters tested. In the first place the



Curve III.—Ferranti Meter.

constant at low currents was found to have a low value, giving a curve of quite a different shape. Then it was noticed that for any given value of the current the constant varied according to whether the current had risen or fallen to that value, and a third peculiarity is that its temperature co-efficient is very small and positive as the constant increases and the temperature rises. Its mean value is about 0.007 per cent. per °C.

The same meter was very carefully tested for variation of constant with current by Messrs. Nelson, Kerr and Gray, students at the Central Technical College, as well as by myself, and I am indebted to them for some of the following results. Previous tests had shown the nature of the curve, viz., that the constant apparently began at a very low value just after the meter started, and rapidly increased with increasing current. A few preliminary readings gave a similar result, and as it appeared to be due to the residual magnetism overbalancing the friction, the effect of demagnetizing was tried, and gave the marked result shown graphically on Curve III. In carrying out all the tests with this meter it was found necessary to put it through a regular cycle of current, starting from zero, increasing to a maximum, and decreasing again to zero. The constant was taken at frequent intervals, and the first cycle shown completely on Curve IIIa clearly indicates the effect of unbalanced friction. As the current is increased from zero to a maximum, the constant, commencing at a high value, descends in a sort of hyperbolic curve, exactly as one would expect it would if there were a constant excess of retarding torque over driving torque. During the remaining half-cycle we have again what would be looked for if there were a constant excess of driving torque over retarding torque, namely, an inverted hyperbola. This course bends up very sharply just before reaching the stopping current.

This operation was continued until the curves for two succeeding cycles were nearly coincident, which occurred with those of the third and fourth cycles. These are shown graphically on Curve IIIb, from which it will be seen that, although the curves for the different cycles appear to be very irregular, still they all lie chiefly within an area enclosed by the descending half of the first cycle and the ascending half of the fourth cycle. The irregularities may be accounted for by variations in the lag of magnetization caused by some such disturbing influence as vibration.

On Sheet IIIc. will be found curves showing the maximum variation of the constant with current and the mean value at any given current. The dotted curve indicates the amount to which the constant may vary at any given current by reason of variation in the lag of magnetization. For increasing current this lag causes a decrease in the driving torque, and consequently a higher value of the constant than is the case when the current is decreasing. In ordinary working, however, these effects of lag would probably neutralize each other, and the mean curve shown in full line would represent mean working value of the constant.

TABLE II.—Schuckert Meter.

Maximum current 15 amperes. Pressure 110 volts. $a = 1$, $K = 0.5$. Current varied.

Current A.	At −4°C.		At 20°C.		At 41°C.	
	w	K	w	K	w	K
1	0.0577	0.530	0.0597	0.512	0.616	0.496
2	0.1178	0.519	0.1225	0.499	0.1256	0.487
5	0 2975	0.514	0.3110	0.492	0.3180	0.482
7	0.4160	0.515	0.4290	0.459	0 442	0.485
10	0.5910	0.518	0.6105	0.5015	0.625	0.489
12	0.7065	0.519	0.7300	0.5025	0.754	0.487
15	0.8925	0.516	0.9205	0.499	0.946	0.486

TABLE IIa.

Pressure varied. Current = 15 amperes.

V	w	K
100	0.546	0.510
105	0.574	0.509
108	0.590	0.509
110	0.599	0.510
112	0.6125	0.509
115	0.627	0.510
120	0.645	0.509

TABLE III.—Ferranti Meter.

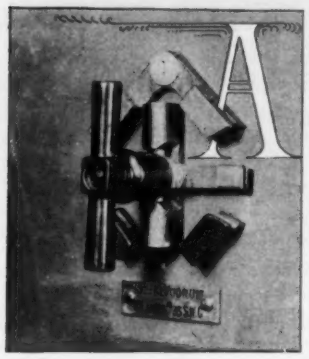
Maximum current 25 amperes. Current varied. Temperature 19°C. $a = 43$. $K^1 = 1$.

Current A.	Current increasing.		Current decreasing.		Mean.
	w	K	w	K	
0.5	0.0658	0.906	0.085	0.700	0.803
1	0.1285	0.930	0.1458	0 820	0 875
2	0.2460	0.972	0.2755	0.867	0.920
3	0.3622	0.990	0.4020	0.894	0.942
4	0.4775	1.001	0.527	0.909	0.955
5	0.5940	1.005	0.653	0.917	0.961
10	1.180	1.012	1.266	0.943	0.978
15	1.755	1.020	1.856	0.965	0 993
20	2.330	1.024	2.419	0.988	1.006
25	2.915	1.025	2.950	1.013	1.016

Electricity in Honduras.

Mr. E. B. Sweet-Escott, the Colonial Secretary of British Honduras, has advertised for bids by American firms, for an electric lighting plant on the three-wire system for the town of Belize, the capital of British Honduras. The bids must cover boilers, engines, dynamos, accumulators, mains, lamp standards, switches, fixtures, incandescent and lamps, meters, etc. The British Consul at New Orleans has the matter in hand.

The Lighting Plant on the "Rotterdam."



A NEW ship called the "Rotterdam" has been added to the fleet of the Netherlands-American Steam Navigation Company, plying between the ports of Holland and New York City. While the "Rotterdam" is not exceptional in point of size, her electrical equipment has some features so entirely unknown in American practice that it is of great interest.

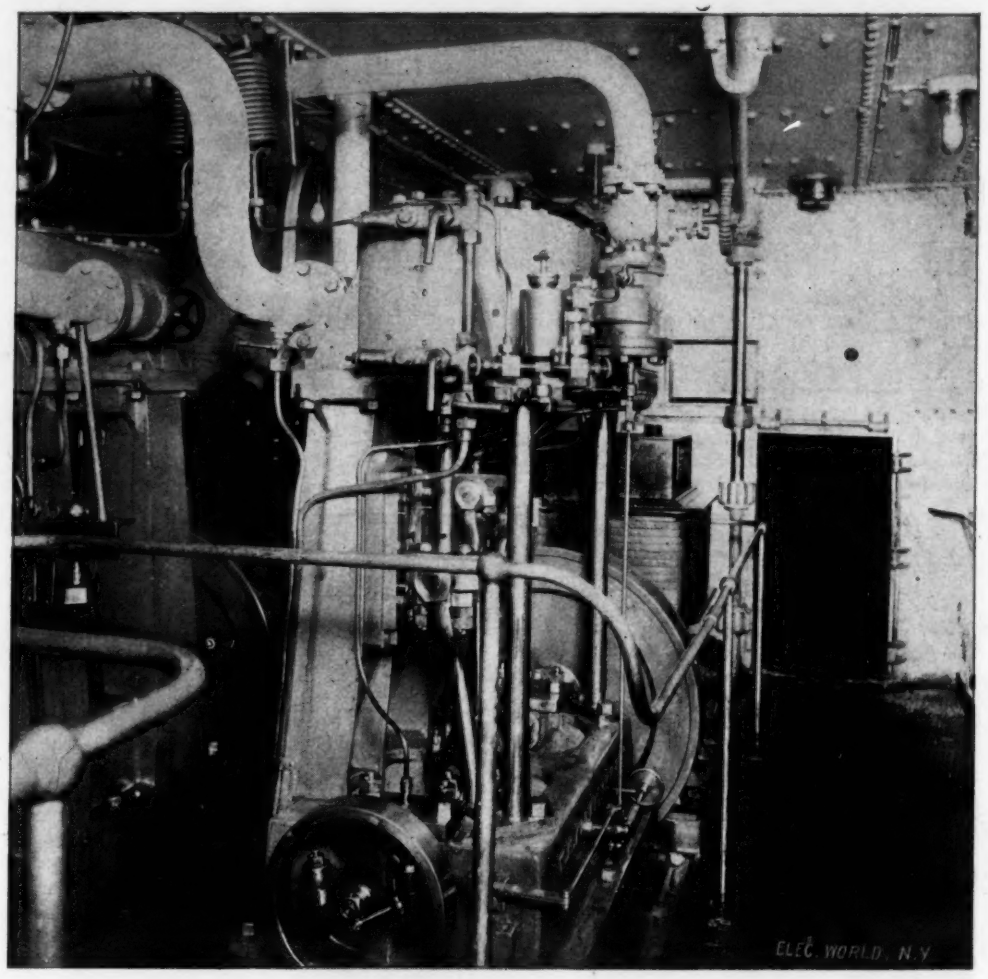
The ship is of 8300 tons burden, and measures 480 feet in length over all. She is propelled by twin screws, driven by triple-expansion engines of the conventional type. The first noticeable feature on entering the engine room is the fact that there is no longitudinal bulkhead between the main engines, leaving the space free and very comfortable for her engineers. Immediately aft of the main engines, on a level with the main shafts and between the thrust blocks, are placed a carbonic-acid refrigerating engine and storage tanks. Immediately aft of this engine and on each side of the midship line are placed the lighting units. There are two of these side by side, their shafts running fore and aft. The engines are vertical cross-compound, with cranks set at 180 degrees to minimize vibration. One eccentric rod drives the piston valves of both cylinders. Exceptionally heavy fly wheels are mounted on the shafts between the cranks and the direct-connected armatures to smooth out the rotative speed. The dynamos were made by W. H. Allen, Son & Co., of London and Bedford, and are of what would be called in this country the Edison bipolar type. The field magnets appear to American eyes remarkably massive.

One of the peculiar features of this plant is that the normal voltage of the lamps is 52 volts. The dynamos are constructed to carry 275 amperes each at a maximum of 62 volts at 250 revolutions. Another interesting feature is that the ship's hull is used as a common return. The main lead from one brush is led to the series coil of the field winding, and thence is grounded by a terminal bolted to the field piece. As the dynamo and engine base is riveted to the ship's framing this gives a good ground. Another interesting feature is that there are absolutely no field rheostats, the field being connected straight across the brushes. The initial voltage is controlled simply by adjusting the speed of the engines. The engine speed is governed by a steam throttle controlled by a shaft governor. Between the governor and the throttle there is a screw actuated by a small hand-wheel. By turning this hand-wheel the speed of the engine can be very nicely adjusted, and the voltage controlled accordingly.

The two dynamos are not run in parallel, there being no provision for so running. The single terminal leads are led to the switch-board and thence the current distributed to the ship's feeders by a set of double-throw feeder switches. There are no dynamo switches. The feeder switches are not constructed as in America, to swing in an arc normal to the board, but move in a plane parallel to the face of the board. They resemble very much in appearance the headboard switches of small Edison dynamos, as arranged for three-wire working. One of these switches is shown in the initial illustration. It comprises an upper terminal connected to the feeder, a multiple blade knife attached to the handle and two lower terminals attached one to each dynamo lead. By throwing the knives from one side to the other, the feeder is switched from one dynamo to the other. By leaving the knives in central position the feeder is left on open circuit.

There is one Evershed voltmeter in the centre of the board, with a three-point voltmeter switch for throwing it on to either dynamo. There are no ammeters in the system whatever. The engineer soon finds out the relative magnitude of the loads on his different feeders, which are approximately constant, and distributes them properly, with a little help from his voltmeter or a glance at his brushes, which will tell him if either generator is overloaded. The governor rod has a long motion and a glance at that gives a fair indication of what the load on either machine is.

The wiring on the ship also differs from American practice. There is no conduit work, the wiring being of stranded conductors, rubber-insulated and armored with steel wire. These little steel wire cables are carried around the ship and simply fastened up with iron cleats. In the neighborhood of the bridge concentric wiring is used to eliminate any magnetic influence on the compasses. There are about 600 lamps wired on the ship, and in the evening, when at sea, both dynamos are required to carry the load. Either one dynamo or the other is always running. The arrangement of the sockets and connectors in such exposed places as the engine room is interesting. The sockets instead of being made of spun or stamped metal are heavy castings, rigidly screwed to the steel bulkheads or ceilings. The connectors are also heavily built, with shells about one-eighth of an inch thick, and fastened in by a bayonet joint. A solid brass screw cap is provided, to be screwed on when the socket is not in use. A similar arrangement is provided for on the main decks to give outlets for deck lights for loading at night. One of these outlets, which looks like a fire-plug, and a group of lamps in its reflector, are shown in the illustrations.

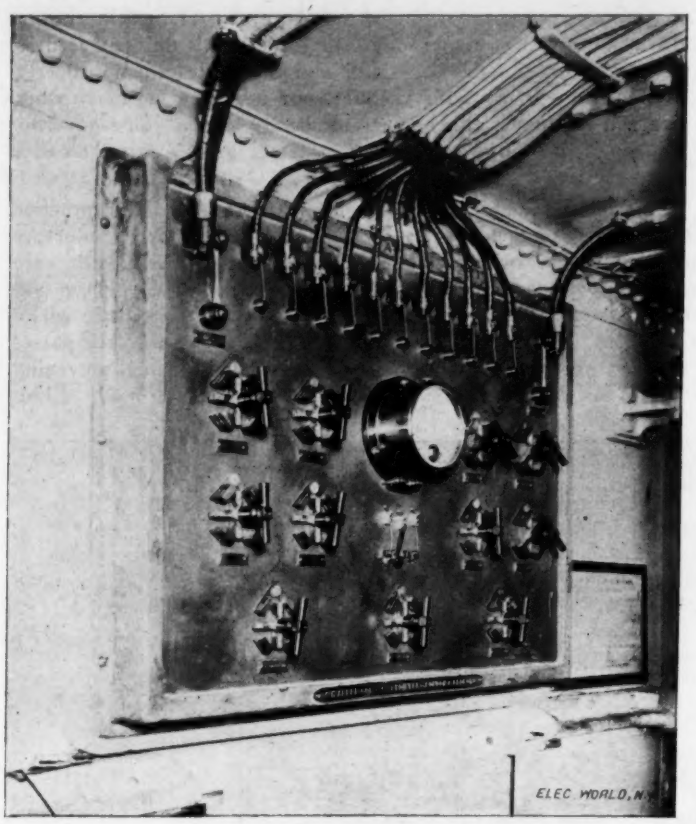


DIRECT-COUPLED ENGINES SHOWING GOVERNOR.

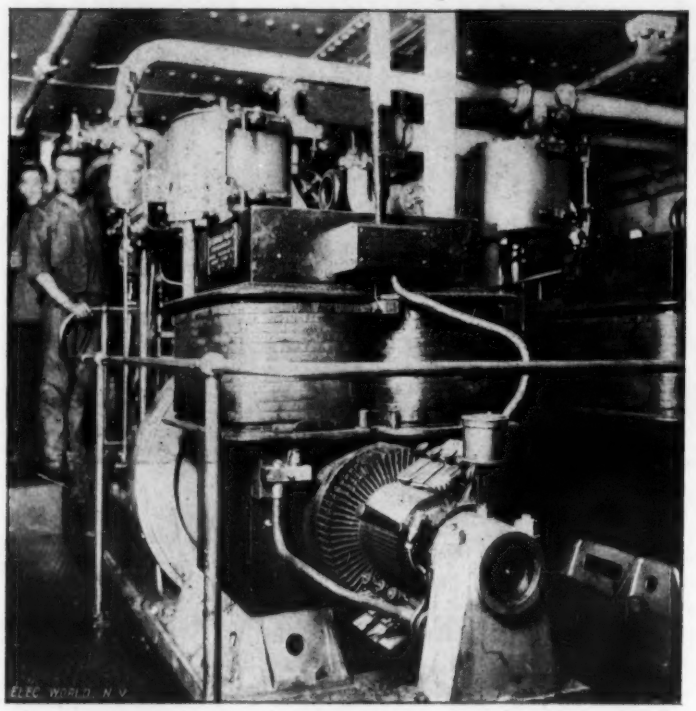
In the first cabin smoking-room is placed an electrical cigar lighter. This consists of a network of platinum wire bedded on a pad of asbestos and mounted on a handle containing an auto-

matic switch, which throws it in circuit when it is held in the proper position for lighting a cigar, and opens the circuit when it is hung up on the hook. The switch apparently consists of a partially filled column of mercury, with proper contacts.

It is noticeable that there are in this plant fewer provisions for



The Main Switchboart.



Direct-Coupled Dynamos.

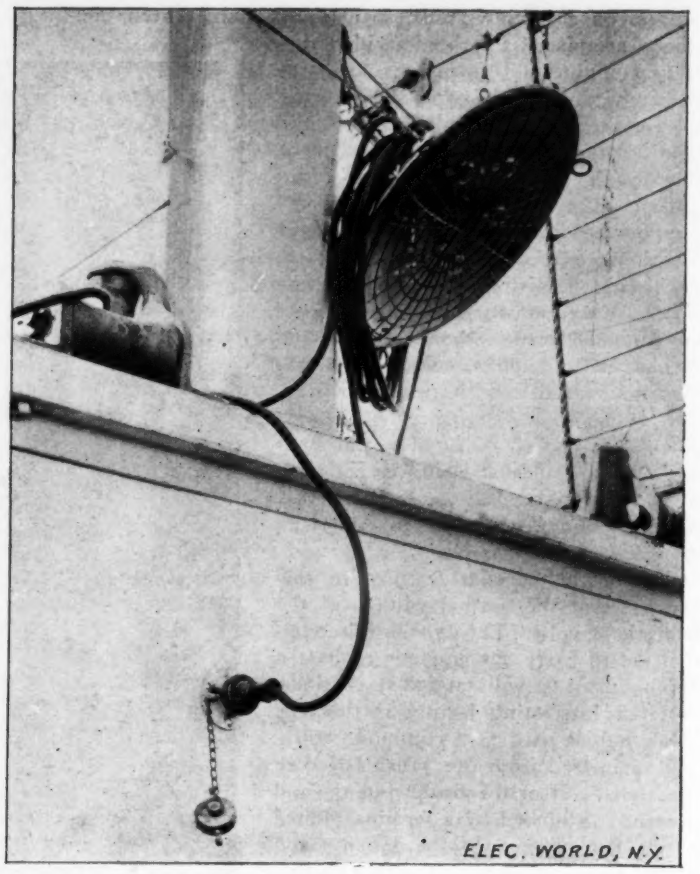
emergencies than are customarily made on shipboard. There is no reserve dynamo, for instance. The attempt has apparently been made to so forestall any emergency by extreme simplicity and solidity of construction that no provision for emergencies will be necessary.

Advertising More Desirable Than Litigation.

In dismissing the complaint of the manufacturers of an electric switch, charging infringement of patent, Judge Putnam, of the United States Circuit Court, at Boston, last week, made a practical and sensible suggestion, in these words: "If the complainant has any remedy, it is not in the courts, but in convincing the purchasing public that the device of the respondents is less simple, economical and compact than its own."

The method of "convincing the purchasing public" the learned judge seemed to think it was unnecessary for him to mention. Put in different language, his suggestion in effect is: "Instead of wasting money, time and effort on lawsuits, advertise your goods, so as to bring them prominently before the trade; see that they are to be found in the hands of the jobbers, and, if necessary, have your traveling representative bring their merits to the specific attention of those who are as much interested in buying your goods, if they are what they want, as you are in selling them."

Judge Putnam in his remarks again declared the truth of the wise and ancient proverb that no money has ever been made from litiga-



Hatchway Light and Outlet.

tion. Many electrical manufacturers have spent much good coin of the realm in fees to lawyers, but The Electrical World does not know of an instance where the outcome seems to have justified even the outlay. If the same amount had been spent in improving the product and "in convincing the purchasing public" by advertising and otherwise of the excellence of the manufactured devices, the result would have proved infinitely more advantageous to the manufacturers themselves, as well as to the electrical industry as a whole.

Meeting of the Association of Edison Illuminating Companies.

The convention of the Association of Edison Illuminating Companies, which has been called by Mr. W. S. Barstow, secretary, will take place at Niagara Falls, September 14, 15 and 16. The convention will be held at the Cataract House. Sessions will be held mornings and evenings of the three days, the afternoons being devoted to the entertainment of the representatives, ladies and guests. The programme of the convention will consist of papers and discussion on matters of immediate interest to the Edison companies, such as current charges, photometer problems, storage batteries, economy in distribution, recent developments in measuring instruments, besides the reports of the various committees.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Slot and Tunnel Armatures. DuBois. *Elek. Zeit.*, Aug. 19; translated in the Lond. *Elec.*, Aug. 27.—An article supplementary to the one by Dobrowolsky (see *Digest*, Aug. 21). In general he agrees with the views expressed, but not with all the deductions; he believes the stability of the well-jointed structure for which we have to thank Faraday and Maxwell (referring to the lines of force theory) is in no way threatened, but he warns against the too literal conception of the lines of force theory. A satisfactory explanation can be obtained if we allow that the field in the slots or tunnels is weak on account of the screening action of the teeth, but not, as was claimed, that it is altogether absent; he discusses it briefly from a mathematical standpoint, assuming a hollow magnetic cylinder with an axial conductor, and gives the expression which he found for the highest limit of the screening action; he shows that the walls of the cylinder may be made as thick as one likes, but the weakening of the external field will not be more than about one-quarter of the permeability, the number being about 100, showing that the internal space will contain a field of about 1 per cent. of the other; the principal force, therefore, is exerted on the iron cylinder and only a small portion on the conductor; the superposition of the circular magnetization on the cross magnetization gives an unsymmetrical distribution of the lines of force by means of which the force can be pictured; this is also true for ring magnets; "a ring magnet experiences a side thrust when in an external field, whose lines of force are in the same plane as the ring; and conversely it exerts a thrust in the opposite direction upon the supporter of the external field"; this deduction, which he states is astounding at first sight, he has verified by experiments. He then discusses the corresponding induction phenomena, preferring to use the theory of tubes of induction, which tubes may be considered as expanding and driving other tubes before them, a process which does not take place in jumps. He promises a more thorough theoretical and experimental discussion.

Iron Losses in Transformers. Burnie. Lond. *Elec.*, Aug. 27.—Two years ago there appeared an article by Feldman on the influence of the shape of the curve upon the iron losses, which article was severely criticised; in the present one the author claims that the fundamental part of Feldman's process is neither admissible nor desirable, the former because the harmonic components of the magnetization and current waves do not correspond with one another, and the latter because all the problems of iron losses can be treated by considering merely the maximum induction; if the eddy currents are neglected the problem may be treated simply by the consideration of those facts which were known at that time; researches have shown that even when the eddy currents are taken into account the total iron loss depends upon the maximum induction; that is, upon the area of the potential difference wave; it is then easy to express the condition that the area of this wave shall be small for any particular effective value of the voltage. He then discusses separately the case for several waves, one of which is the combination of the first and third harmonic and the other the combination of three harmonics; he includes the best and worst wave forms for both cases. The idea of the magnitude of the various losses may be gotten from the application of one of the empirical formulas which have been used to connect iron losses and magnetism inductions. Curves, formulas and tables of data are given.

Small Motor.—Cosmos, Aug. 7.—An illustrated description of the Lecoq motor, which is made as small as 0.1 horse-power, and has an efficiency as high as 65 per cent.; its construction differs from that of other small motors, chiefly in the form of the polar pieces, which almost entirely surround the cylindrical armature, giving a very intense magnetic field with very little dead wire; the speed is 250 revolutions; the weight is 19.8 pounds.

Diphase Current Installations for Laboratory Instruction. Hanappe. *L'Eclairage Elec.*, Aug. 21.—The first part of an article giving a very complete description of the diphase machine and appurtenances, which is used for instruction purposes at the school at Mons; characteristics and curves of the wave forms are given.

Construction of Armature Cores. Baxter. *Amer. Mach.*, Sept. 2.—An illustrated article of a practical nature, giving hints regarding the construction.

Universal Laboratory Alternator. Carhart. *West. Elec.*, Sept 4.—The synopsis of a paper read before the A. A. A. S. He describes an easily constructed machine intended for laboratory purposes; both the field and the armature have poles, the latter two more than the former; the armature is stationary; the observed and computed values of the voltage and the various conditions are given and show very good agreement.

400 H-P. Induction Motor.—West. Elec., Sept. 4.—An illustration of the one recently installed at Niagara Falls; it is said to be the largest Tesla induction motor ever made; it runs directly from the 2000-volt mains.

LIGHTS AND LIGHTING.

Comparison of Electric and Petroleum Lights. L'Energie Elec., July 1.—The results of some tests (apparently rather crude), which were made with incandescent and petroleum lights with and without reflectors and shades; the light below the horizontal plane was that which was measured, and the curves of the results are given; that for the incandescent lamp is nearly a quadrant of a circle, while for the petroleum lamp it is not regular, but has a very decided maximum point at about 30° from the vertical; from these results the cost of the two lights is compared and found to be practically the same; the spherical illumination was obtained by averaging the horizontal, the vertical and that at 30° (a method which is open to question).

Relations Between Arc Curves and Crater Ratios. Mrs. Ayrton. Lond. *Elec.*, Aug. 27.—An abstract of a British Association paper. With a solid negative the voltage between the carbons varies according as the positive carbon is cored or solid; the present researches were made with the cored positive; the abstract is confined chiefly to the results, the voltage having been observed when each one of the other variables in turn was kept constant. For a constant length of arc the voltage is higher with solid than with cored carbons; with the solid it diminishes as the current increases, and with the cored it either diminishes much less or remains constant for all currents above a given value, or actually increases with the current after falling to a minimum. With a constant current the voltage is always higher with solid than with cored positive carbon, the difference diminishing with longer arcs; the rate of change of voltage to change of length is constant with solid, but diminishes as the arc increases with cored carbons; this rate becomes smaller and more nearly constant as the value of the constant current increases; the voltage with zero length of arc diminishes as the current increases with a solid, but increases with the current with a cored carbon. These differences can be accounted for by the hypothesis that "with a given solid negative carbon and a positive of a given diameter the P. D. required to send a given current through a fixed length of arc depends principally, if not entirely, on the nature of the surface of the crater, being greater or less according as the carbon of which this surface is composed is harder or softer." With constant currents she tested the hypothesis by finding how the area of the crater varied with the length of the arc, and obtained satisfactory results; she deduced the following results: "When a cored positive carbon is used and a constant current is flowing the area of the crater must increase as the length of the arc increases; the change that takes place in the ratio of the soft carbon to the total amount of carbon in the surface of the crater with a given change of length must diminish as the arc increases in length; the change that takes place in the ratio of the soft carbon to the total amount of carbon in the surface of the crater with a given change of length must be smaller, and the rate of change must become more nearly constant for all lengths of arc as the value of the constant current increases;" calling the ratio of the area of soft carbon to the area of the crater the "soft crater ratio" these three conditions may be put as follows: With a cored positive and a constant current the crater area must increase and the soft crater ratio diminish as the arc length increases; the change of soft crater ratio with change of length must diminish as the length increases; the change of soft crater ratio with change of length must be smaller and the rate of change becomes more nearly constant the larger the current. The accuracy of these conclusions were tested with very satisfactory results. It was also found that with constant lengths the crater area less a constant depending on the length, is proportional to the current; that the change of area of crater with a given change of length of arc is independent of the value of the current, and with a given change of current it is independent of the length of the arc.

Constant Potential Lamp for Alternating and Continuous Currents. Bardon system. *L'Eclairage Elec.*, Aug. 21.—An illustrated description of the new form of this lamp, in which the brake principle is used.

Constant Potential Arc. Rau and Vaughn. *West. Elec.*, Aug. 28.—A reprint of a paper read before the Northwestern Electrical Association.

They claim that the constant-potential arc is not used in the smaller plants as much as it ought to be; they do not advocate its extensive use, but claim that it should be used to keep a customer; if used, the customer's bill will be about half that for Welsbach lamps; they advocate that the customer pays for the lamp and obtains a remittance less 10 per cent. when returned; such a lighting from incandescent circuits is not as desirable as incandescent lighting, but it may be the only method in certain cases to successfully meet competition for other artificial methods of illumination. The advantages and disadvantages possessed by the several types of incandescent arc-light systems are then discussed; the enclosed type of arc lamp has lately been quite successfully adapted to alternating currents and they believe it to have a brilliant future.

Maxim's New Incandescent Lamp—Dispatches to daily papers from London stated that Maxim has made a new incandescent lamp filament of a mineral substance, the material being kept a secret; it is said to have a life of 1000 hours with an efficiency of 2.8 watts per candle-power; the cost is given variously as 1 and as 0.1 cent.

POWER.

Developing a Large Water Power.—Canadian Elec. News, July.—The falls of Kootenay in British Columbia, 10 miles from Nelson, are to be utilized to develop 2000 horse-power, and ultimately 10,000; the power is to be used mostly for mining work; three-phase alternating currents are to be used; the units will be 1000 horse-power, and the transmission voltage 20,000, the distance being about 30 miles.

Applications of Electricity to Artillery. Lavergne. *Rev. Gen des Sciences*, July 15.—A long illustrated article giving a number of descriptions of such applications of electricity, including some methods for measuring the velocity of a shot, for moving cannon, turrets, etc., with special reference to French apparatus.

Diphase Transmission Plant.—L'Energie Elec., Aug. 1.—An illustrated description of the plant at a paper factory at Romagnano, Italy; the water power is 5 km distant; there are three turbines of 270 horse-power each, driving three alternators of 3600 volts at 180 revolutions and a frequency of 500.

Electric Plowing.—L'Elec., Aug. 21.—An illustrated description of the Borsig system, which is used in a number of places in Germany, especially in connection with the raising of beets for sugar; other descriptions have already been noticed.

Power Transmission at Geneva. Friedmann. *L'Elec.*, Aug. 14 and 21.—The conclusion of the description noticed in the *Digest*, Aug. 28.

Garbage as a Fuel for Electric-Lighting Stations.—Eng. News, Aug. 26.—An editorial article in which some reasons are given why the success of the plan of generating electric current from garbage is very problematical even in England, and it is quite certain to prove a failure in the United States, except, possibly, under some unusual conditions.

Failure of Gas Engines in Lighting Stations.—Eng. News, Aug. 26.—Reprints of portions of the recent articles in the London papers on the Coatbridge station, in which, as also at Belfast and Morecambe, steam has been adopted after a trial of gas engines.

An Electrically Operated Drawbridge.—St. Ry. Jour., Sept.—An illustrated description of the method employed in Toronto for operating a drawbridge 260 feet in length by means of an electric motor of 12.5 horse-power. The motor is not geared to the pier, but is located at one end of the bridge, and opens and closes it by means of a chain connected to the shore and wound around a pulley driven by the motor. The chain is carried on the guiding wheels on the bank.

Electric Drill. Hay. *Eng. and Min. Jour.*, Aug. 28.—An abstract, with the illustration, of a recent paper before the Institution of Mining and Metallurgy, describing the electric drills at the Rosedale iron mines in Yorkshire, England; the drill is connected with the motor by a flexible shaft; it will drill 3-foot holes 1.25 inches in diameter in twenty-three seconds in oolitic iron stone.

TRACTION.

Locomotives for the Jungfrau Railway.—Lond. *Elec. Eng.*, Aug. 27.—A brief, illustrated description of the locomotive to be used on this mountain railway. There are two motors of 125 horse-power each, driving the main cog wheel hrough a double reduction gearing; the highest output will be 300 horse-power; each locomotive contains three methods of braking; the tractive effort is 14,500 pounds; these motors are to be used with a three-phase current.

Surface-Contact System.—L'Energie Elec., July 16.—An illustrated description of the Diatto system which is in use in Lyons, France; in this system, which has been referred to a number of times before, there are successive contacts which are rendered active as the car passes over them, the current being collected by means of a long bar underneath the car; the bar is magnetized and by its magnetic attraction it makes the contacts active.

Leeds.—Lond. *Elec. Rev.*, Aug. 27.—A long, illustrated description of the street railway system and some extracts from a report by Hopkinson, who recommends the use of stationary accumulators, which would increase the economy.

Electric Cabs.—Lond. *Elec. Rev.*, Aug. 27.—A number of illustrations, accompanied by a brief description of the works of the new company which has started running electic cabs in London. A description is also published in the *Elec. Rev.* (N. Y.), Sept. 1.

Charleston.—Elec. Eng., Sept. 2, and *Elec. Rev.*, Sept. 1.—An illustrated description of the plant of that railway company.

Boston Subway. Weller. *Elec. Eng.*, Sept. 2.—An illustrated description of the subway.

Electric Cars, Car Houses and Car Repairs in San Francisco. Foster. *St. Ry. Jour.*, Sept.—A review by the electrical engineer of the Market Street Railway Company, of the practice and improvements made in this branch by that company. Single truck cars have been found much superior to double truck, and most of the cars are of the combination open and closed type; lever brake handles are preferred to rotary handles, and overhead gongs to foot gongs. The cars are overhauled at least once in six weeks, the bearings are taken apart and the armatures taken out, whether defective or not, and tested; the Wheatstone bridge is preferred for this work to the ammeter-voltmeter method, on account of its greater accuracy, rapidity, and for other reasons. The brush holders have been changed to give a constant pressure on the commutator, independent of the length of the brush, and a new type of trolley head has been adopted with tapering curved section of the harp, making it impossible for the trolley to lodge in the span wire in case it should jump from the trolley wire. Much attention has been paid to motor lubrication, and oil is now used in place of grease on all bearings' but not in the gear cases; the change means a reduction of $10 per year per car in motor lubrication. The controllers of the K 2 type have been changed by omitting notch 4 and notch 7.

The Suburban Railroad of Chicago.—St. Ry. Jour., Sept.—A considerable part of this system consists of sections of steam roads equipped for operation by electricity; no changes were made beyond suspending a trolley over the track and binding the rails. Steam trains are still operated over part of the tracks, and on this account special attention was paid to the hanging of the trolley wire. The power station contains two tandem compound condensing engines directly connected to generators; the condensing water is supplied to a reservoir from a well 185 feet deep, being raised by compressed air. The Patton electric locomotive was used almost exclusively in putting up the overhead work.

Electric Railway in Charleston.—St. Ry. Jour., Sept.—This is a system comprising 24.5 miles of track, all built during the past year. Charleston has a population (1890) of 55,000, and has certain physical characteristics similar to New York city, being on a long and narrow peninsula. The station contains two tandem-compound condensing engines, each direct-connected to two 200-kw generators; the foundations of the car house are somewhat novel, owing to its erection on land of very little supporting power; the weight of the building is therefore carried on shallow concrete foundations; the cars are all of the centre-aisle cross-seat type. The method of securing sufficient water pressure for fire purposes is ingenious, a head of 100 feet being secured with a 39-foot tank. A diagram of the feeding system is given.

Proper Handling of Controllers. Knox. *St. Ry. Jour.*, Sept.—A description of the method of instruction employed by the Chicago City Railway in teaching its motormen the use of controllers, by which the management has reduced the amperes on an average of 7 to 8 amperes per car when trailers are used, and from 10 to 12 amperes per car with motor cars alone. He believes in accelerating a car slowly, especially on city roads where there are many stops; he found that the power required to get a car to full speed in 85 feet and 9 1-2 seconds was 307,176 watt seconds, against 221,676 watt seconds in getting a car to speed in 12 seconds and 150 feet; the power expended by the slipping of the car wheels in quick acceleration he believes is very much. He cites the case of another road, where by a system of car-current recorders a saving of 9 per cent. in the average power required to operate the road was secured.

Proper Handling of Controllers. Cravath. *St. Ry. Jour.*, Sept.—The disadvantages of quick acceleration are summed at as follows: 1. The change being made from series to multiple before much speed has been attained the efficiency is temporarily reduced one-half, as the horizontal effort per ampere in series is twice that when the motors are in multiple. 2. The line loss being according to the square of the current, the high maximum current required for quick acceleration causes a loss of more energy than the lower maximum required with slower acceleration. 3. Where shunted fields are used motormen will throw in the shunt too soon, weakening the fields, and consequently the horizontal effort per ampere. 4. The heat loss in the motors is much greater with maximum starting currents and their efficiency less. 5. There is more slipping of wheels. 6. More generating machinery is required, and consequently the power-house efficiency is lower.

The Union Elevated Railway of Chicago.—St. Ry. Jour., Sept.—This loop was constructed for connecting the downtown termini of the elevated roads and is being equipped with the third-rail system. The power station has at present a capacity of 7500 horse-power, consisting of Corliss engines directly connected to 1500-kw generators. The system of block signals is especially complete.

Power Station Records in Philadelphia.—St. Ry. Jour., Sept.—Detailed figures of the cost of power-station operation from January to June, 1897.

Car Pits in New Orleans.—St. Ry. Jour., Sept.—A description of a water-

tight car pit employed in New Orleans, where the character of the soil is very spongy.

A Suggestion in Electric Railways. SCHIEMANN. *Eng. Mag.*, Sept.—A brief notice of a recent article in a German paper in which he suggests constructing cheap narrow gauge railways along the main highways of merchandise traffic, and using flat top cars on which the farmers' wagons can be placed and taken to the nearest town or railroad station, without handling or unloading the goods; such railways would be valuable feeders for the trunk lines of some railroads.

Electric Railway Motors. HANCHETT. *St. Ry. Jour.*, Sept.—The third of a series of articles on this subject. In this section the subject of armature-winding diagrams is continued from the previous issue.

Motor Road Vehicles. SACHS. *Jour. Frank. Inst.*, Sept.—The first part of a long article beginning with an historical review and describing in detail the various mechanisms used on such vehicles.

Horseless Carriage Industry in Europe. BEAUMONT. *Eng. Mag.*, Sept.—An illustrated article referring chiefly to steam and oil vehicles; it contains a large number of illustrations.

The Present Status of Electric Car Heaters.—St. Ry. Jour., Sept.—An illustrated description of the improvements which have been made in electric car heaters during the past year, and the standard types for 1897.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Why Some Lighting Plants Do Not Pay. WHITE-FRASER. *Canadian Elec. News*, July.—A short article, in which he points out the importance of considering the efficiency of the whole combination instead of merely that of parts; also the proper determination of the size of the plant, which involves many factors; also of the subdivision into the proper units, citing a certain case as a horrible example, although a fair sample of what will result by leaving the design to those interested in the sale of machinery; the design depends as much on the minimum load as on the maximum, and the full-load efficiency is not of so much importance as that of half load; preliminary engineering is even of more importance than good operation.

Isolated Plants vs. Central Stations. MOSES. *Eng. Mag.*, Sept.—The second portion of his article. He gives tables of data for a number of different installations, enabling the cost of lighting in private plants to be compared with that from central stations; from these he concludes that central station service "can successfully compete with the private supply in small installations, whether separate or aggregate, and in large installations where the load is large and of short duration. In all other cases the power can be delivered more cheaply by the private plant on the premises, though local influences may make its installation inadvisable.

Evolution of Electric Lighting Fixtures. DYER. *Elec. Eng.*, Sept. 2.—A reprint of a recent paper, giving a history of the development of electric fixtures, with special reference to the important part taken by the insulating joint, which is claimed to have been invented by Stieringer.

Automatic Interrupter for High-Tension Circuits.—West. Elec., Sept. 4.—A reprint of the short descriptive article noticed in the *Digest*, July 3 and 24.

Municipal Plants. WINCHESTER. *Elec. Eng.*, Sept. 2.—A reply to a recent article by Francisco in THE ELECTRICAL WORLD, June 5.

WIRES, WIRING AND CONDUITS.

The Use of Aluminum as a Conductor. KERSHAW. Lond. *Elec.*, Aug. 27.—Some calculations of a practical nature. to determine the possibility of its replacing copper as a conductor. Lord Kelvin in his latest determination of the specific resistance obtained 2.58 microhms at 0°, the metal containing only 0.31 per cent. impurities; compared with Dewar's figures for copper, the relative resistances of copper and aluminum are as 1 to 1.65; the conductivity ratios are for equal volumes 1 to 0.605, and for equal weights 1 to 2; some of the figures of Richards and Thomson are also given. He then shows that, in spite of its greater conducting power, weight for weight, aluminum is at present more expensive than copper for the transmission of electrical energy; the price of 99 per cent. aluminum at Niagara is 40 cents per pound in ton orders, and the relative conductivity is 59; the relative conductivities for equal weights are therefore as 1 to 1.94; the price of electrolytic copper in the United States is 10.75 cents per pound; the relative costs of aluminum and copper for an equal carrying capacity are therefore as 40 to 20.85, or nearly as 2 to 1; in England this relation is as 1.55 to 1. It is evident, therefore, that until the price has been considerably reduced its use for conductors cannot be expected to extend. He discusses briefly the reduction in the case that would result from the substitution of bauxite for refined alumina; although this cost is considerably less, it is quite possible that the cost of the subsequent refining would more than balance it.

Calculation of Three-Phase Wiring. SZAPIRO. *Elek. Zeit.*, Aug. 5.—A reply to the answer of Cahen noticed in the *Digest*, Aug. 14. Szapiro claims that the point which he raised has nothing to do with allowable approximations, but that the whole method of Cahen is wrong; Cahen assumed arbitrarily that at unequal loads the three phases of the lamp currents differ by 120 degrees and that the main voltage then also agrees in phase with the lamp current; this, however, leads to impossible results, and it is, therefore, not proper to use the method.

ELECTRO-PHYSICS AND MAGNETISM.

Light Transmitted as Cathode Rays.—Lond. *Elec. Rev.*, Aug. 27.—An editorial notice of an experiment recently made by Woodward (in America), which if confirmed will revolutionize our present ideas of the transmission of light through space. He describes experiments, from which it would seem that no light would pass through a perfect vacuum; but by focusing a powerful Crookes tube on the vacuum bulb the light was transmitted with but little loss. It would follow from this that light can be transmitted only when material particles as well as ether are present; through cosmic space he supposes that light is transmitted in the form of cathode rays, which are converted into ordinary light when they impinge against our atmosphere.

Constitution of the Electric Spark. SCHUSTER. Lond. *Elec.*, Aug. 27.—An abstract of a British Association paper. In a Leyden jar discharge metallic lines of the spectrum are often seen in the centre of the spark path and not merely around the electrodes, thus showing that there must be a velocity of projection; he made some measurements of this velocity, using a rapidly revolving wheel, and he found that while the air lines of the spectrum appear perfectly straight, the metallic lines were inclined and curved; he found that the velocity of the molecules gradually diminishes as they move away from the pole; the average velocity up to about 1 mm from the pole was about 2000 meters per second, while at 4 mm it was about 400. Bismuth lines were decidedly more curved than those of zinc. A more perfect apparatus is in course of construction for making further researches.

Resistance to Variable Currents. POTIER. *L'Eclairage Elec.*, Aug. 21.—A short article supplementary to the recent one in that journal by Brylinsky, who dealt with the question of hollow conductors; the present author used the same series, which gives the only solution of the problem, but in such a way as to obtain results with a precision sufficient for practical purposes, for the thickness of a conductor and a given frequency, so that the energy transformed into heat does not exceed 10 per cent. of that due to the resistance of the conductor; he gives simplified formulas, which are sufficient for most practical cases; also a number of tables of calculated factors.

Limiting Magnetism of Permanent Steel Magnets. ANDREAS. *Elek. Zeit.*, Aug. 12 and 19.—A very long article describing and giving the results of very extended researches to determine the conditions under which permanent magnets of great permanency are to be obtained; the previous work in this direction by Strouhal and Barus is described and discussed at considerable length. By different methods he found which one gave the maximum specific magnetism, and what the resulting temperature coefficients are; he also examined the effect of periodic changes in temperatures on the specific magnetism, and finally the effect of the magnetizing temperature on the final condition of the specific magnetism; many of the results of his researches are given in tables of data. From his work he comes to the following conclusions: That the temperature coefficient of a magnet diminishes with the length of time during which it is exposed to a high heat, and also with the increase of the intensity of the heat during the hardening of the steel; that the limiting magnetism of the steel increases with the increase of the intensity of the heat, and with the diminution of the time of the heating during the hardening; that the amount of limiting magnetism depends on the magnetizing temperature without regard to the temperature coefficient; that it is quicker and more reliable to bring about the permanent condition of the magnetism by sudden cooling between 90 degrees and the lowest temperature at which the magnet is to be used, than by boiling, and that the final condition is reached more easily with magnets having a low than those having a high temperature coefficient; the temperature coefficient increases with the diminution of the specific magnetism in the same magnet and that it is possible to bring a magnet below a specific magnetism inherent to a certain temperature, to which it afterward, in the course of time, will increase again. He then gives briefly the instructions found in the literature on the subject, for the production of permanent magnets; from these and from his researches he draws the following conclusions: that glass-hard steel is preferable to all others but the time during which it is heated should be as short as possible; the sudden cooling should be in water; the magnetizing should be at the lowest possible temperature with a slowly increasing and diminishing current and it is advisable to subject the magnet to concussion parallel to the axis several times during the time of the maximum current; the method of immersing the magnet alternately in boiling water and a freezing liquid is the quickest way to bring it to a constant magnetic moment (this appears to differ from a statement above); the duration and number of these operations depend on the cross-section of the magnet; with a cross-section of 7 sq. mm for instance, about 30 times, each for a minute, with smaller cross-sections less and with larger ones more; a magnet so constructed will not be affected by ordinary temperatures nor by a blow.

Curious Alternating Arc Phenomena. HAY. *Elec. Rev.*, Sept. 1.—A review of the article abstracted in the *Digest*, Aug. 28.

Electrical Discharges in Air. TROWBRIDGE. *Am. Jour. of Sc.*, Sept.—A short article describing experiments with a flaming discharge from a large accumulator; with this discharge he endeavored to discover what he

calls the mechanism of the voltaic arc. He studied the apparent resistance of the voltaic arc obtained from an 80-volt accumulator battery, with a choking coil in series and a condenser connected to the terminals of the arc and at the same time to the terminals of a transformer, thus producing an oscillatory discharge through the arc; the spark in the gap of the condenser circuit was photographed; he finds that the apparent resistance of the voltaic arc does not follow Ohm's law; he believes a disruptive discharge accompanies a flaming discharge and serves as a species of pilot spark; a variable voltage is necessary to maintain the disruptive discharge, and this potential makes itself evident as an apparent change of resistance. He also used 5000 Planté cells in connection with a Planté condenser, obtaining sparks 9 to 10 inches long, photographs of which are given; when these were passed through Crookes tubes no difference of definition could be noticed at the cathode or anode, but there was a great difference in the actinic effect. What is supposed to be a resistance in the case of the voltaic arc and similar discharges he believes to be a polarization which produces a variable difference of potential.

Oscillatory Discharge of a Large Accumulator. Trowbridge. *Am. Jour. of Sc.*, Sept.—A short article on researches with the discharge from a large number of Planté cells. There was a flaming discharge, with a bright spark as a nucleus; he examined whether this was oscillatory or not, and found from the photographs that it was, as many as five or six clearly defined oscillations being noticed. He makes some mathematical deductions, based on the supposition that each cell of the battery can be regarded as a leaking condenser; he concludes that the Planté cells evidently act like leaky Leyden jars connected in series; 5000 cells gave an apparent capacity of about 500 electrostatic units. Since this discharge is oscillatory he believes that the discharge from any primary battery is also oscillatory; in nature, oscillatory discharges are the rule and unidirectional ones the exception.

Solarization Effects in X-Ray Photographs. Robb. *Am. Jour. of Sc.*, Sept.—In ordinary photographing it is well known that with an overexposure the developed plate may be a positive instead of a negative, this phenomena being called solarization. The experiments which he has made show that similar effects are produced by Röntgen rays, and they have a very important bearing on the distinctness of the photographs, offering a simple explanation of the halos which so often appear. He describes the apparatus used in his experiments, and reproduces a number of the results; these seem to prove conclusively the possibility of photographic plates becoming solarized by Röntgen rays, which adds one more to the properties possessed in common by these rays and ordinary light; the most important conclusion is the necessity of carefully timing exposures, as much of the indistinctness in X-ray photographs he believes is due to overexposure rather than to under exposure.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolysis of Water. Nernst. Lond. *Elec.*, Aug. 27.—A brief editorial notice of a recent address before the German Chemical Society. From this it appears that water is considered to contain three ions, oxygen, hydrogen and hydroxyl; this gets over the difficulty to explain why it required 1.68 volt to electrolyze water while the maximum E. M. F. which can be obtained by the recombination of oxygen and hydrogen in a gas battery is only 1.08 volts; Smale has shown from thermo-dynamical considerations that this is the maximum value obtainable from hydrogen and oxygen at atmospheric pressure; Le Blanc believed that oxygen was in a state of supersaturation before its escape as gas; Nernst repeated Le Blanc's experiments, obtaining hydrogen and oxygen with an E. M. F. of 1.08 volts; the difference in the voltage for the composition and decomposition is now explained by supposing that oxygen ions as well as hydroxyl ions are always present in the water and that the lower E. M. F. is the one at which the former is liberated, while the higher is that at which the separation of hydrogen and hydroxyl takes place.

Gas and Carbon Consuming Batteries. Case. *Elec. Eng.*, Sept. 2 and *Elec. Rev.*, Sept. 1.—A reprint of a short British Association paper giving briefly the results of experiments. These show that platinum or its compounds are not necessary to produce the combination of the gases; also that carbon is oxidized to carbonic acid gas at the normal temperature without heat and with the production of electrical energy; both the electrodes in some cases were porous carbon tubes. A chlorine-carbon cell is described, the chlorine gas passing through a porous carbon tube electrode, the other carbon having been heated red hot; the liquid was hydrochloride acid; the voltage was about 0.5; the internal resistance was very high; the resulting liquid was found to contain carbon dioxide and hydrochloride acid; the same action took place in the dark; a negative platinum electrode did not give as good results; powdered carbon as one pole and platinum as the other, the chlorine being near the platinum, gave 0.6 volt with a smaller but steadier current; with graphite the current fell more rapidly. With a carbon monoxide chlorine cell 0.38 volt was obtained with the aid of porous carbon tubes. With chlorine at one electrode and marsh gas at the other the voltage was 0.6 to 0.7, but the cell rapidly polarized; carbon dioxide was found in the liquid.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Capillary Electrometer. Behn. Lond. *Elec.*, Aug. 27; abstracted briefly from the *Wied. Ann.*, No. 8.—Warburg's theory of the phenomena of this instrument involves the supposition of a solution of mercury by an electrolyte containing air; to establish this theory the present author endeavored to prove the existence and examine the nature of the mercury salt in solution; the results were a success; the experiments are imperfect, but as far as they go they substantiate the conduction-current theory.

Determining the Forms of Current Curves. Armagnat. *L'Eclairage Elec.*, Aug. 21.—An article belonging to his long series on measuring instruments; in the present installment he describes some of the methods for determining the forms of the current waves, including descriptions of oscillographs.

Interrupter for Ruhmkorff Coils.—Lond. *Elec. Rev.*, Aug. 27.—A brief illustrated description of the one made by Ducretet and Lejeune, recently mentioned in these columns.

Photometer. S. P. Thompson. *Elec. Eng.*, Sept. 2.—A brief abstract of a description of his new photometer at the British Association meeting. The advantages are simplicity and that it requires less space than the usual straight benches. It consists of two benches at right angles, the junction being in the corner of a room; a flat disc of white blotting paper is placed at an angle with each of the two benches and screens are so placed that each half of the white disc is illuminated by only one of the two sources; the screen is rotated until the two halves appear equally illuminated by the two sources when looked at in a direction bisecting the angle between the two benches; the intensities will then be proportional to the tangent of the angle through which the disc has been turned.

Electrical Determination of Specific Heat. Callender and Barns. *Elec. Eng.*, Sept. 2.—A brief synopsis of a British Association paper, describing a new method of determining the specific heat of a liquid; the method is an electric one and consists in balancing the heat generated by a current against the heat carried away by a steady stream of the liquid, the advantage of the method being that all the conditions are steady. The value which they obtained for the specific heat of mercury at 28 degrees C. was 0.13905.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Submarine Telephone Cables. Barbarat. *L'Eclairage Elec.*, Aug. 21.—An abstract of a criticism of a paper by Preece read at the British Association meeting last year. He agrees with Preece in some points and differs radically in others; he concludes from calculations of the form of cable proposed by Preece to be used between England and Germany that it would not fulfill the requirements with present telephonic apparatus, but it would serve well for telegraphic purposes, and he therefore suggests that it be experimented with, because, if not successful for telephony, it will at least be much better for telegraphic communication than the present cables.

Working Telephone Exchanges from Lighting Currents. Smith. Lond. *Elec. Rev.*, Aug. 27.—A suggestion of a method which he claims would be much more economical than batteries or accumulators for working telephone exchanges. It consists in the use of a number of resistances inductively wound and placed in series with a suitable choking coil in order to eliminate the pulsating effects of the dynamo currents; the telephone circuits are then shunted from these resistances. The method has been in use experimentally on a 110-volt lighting circuit.

Ader Recorder.—L'Eclairage Elec., Aug. 21.—A horizontal section belonging to the description which was noticed in the *Digest*, last week.

MISCELLANEOUS.

Submarine Vessel. Bailly. *Cosmos*, July 24.—An illustrated description of the one devised by Pozzo, which is intended for working and exploring at great depths; it will stand a pressure of 50 atmospheres and is lowered from a vessel; it is spherical in shape, has propellers for moving and steering it, and is supplied with current by accumulators all through the suspension cables.

Physiological and Therapeutical Action of High-Frequency Currents. d'Arsonval. *Bul. Soc. Int. des Elec.*, April.—A reprint of his long paper before that Society, which was abstracted in the *Digest*, May 1 (see also May 29).

Meeting of the Union of German Electricians.—Elek. Zeit., Aug. 5.—A very long verbatim report of the proceedings of the recent meeting at Eisenach; references to this meeting have already been given; the papers read have been or will be published separately; these proceedings are largely of local interest only. The report concerning rules and regulations for high-tension installations is discussed at some length; a brief reference is given to the report of the committee on incandescent lamps, which was not final; it includes the description of the Heller system for measuring incandescent lamps (referred to before in these columns); the report concerning the photometric units is given; a committee was appointed to report on a uniform socket for incandescent lamps; Fleischhacker read a long paper on the objects and accomplishments of that society; the discussions of a number of the papers are published, but these, if of interest, will be noticed in the *Digest*, together with the papers.

British Association.—The Lond. *Elec. Eng.* publishes the presidential addresses of the various sections; those so far published seem to have no connection with electrical subjects.

Brussels Exhibition. Scott. Lond. *Elec. Eng.*, Aug. 27.—Brief account of the electrical exhibits, including a relatively long one of the Behr monorail railway, on which it appears that the first time a train ran

it attained a speed of over 70 miles an hour, but the strain produced changed the angle of the rails.

Educational Requirements for Electrical Engineers.—Eng. Mag., Sept.—An abstract of the recent editorial article in the Lond. *Elec. Rev.*, July 9.

Protection Against Lightning. ATKINSON. *Elec. Eng*, Sept. 2.—A short article calling attention to the ignorance, prejudice and misapprehension which prevail in regard to lightning rods; there is a general impression that lightning rods afford no protection; he admits that a badly constructed rod may be very dangerous and worse than none; a good one may be very cheaply constructed; he recommends copper ribbon or tape, ending in a copper rod terminating in points, and the lower end extending to permanently moist earth; the conductors should not weigh less than six ounces to the foot, and should be electrically connected to every metallic part of the building; in modern, high office buildings it would be sufficient to extend copper terminals from the top of the building and connect them with the steel frames.

Electrical Development in England and France. MCGHIE. *West. Elec.*, Sept. 4.—An article comparing the development in those countries with that in America.

A New Multipolar Dynamo.

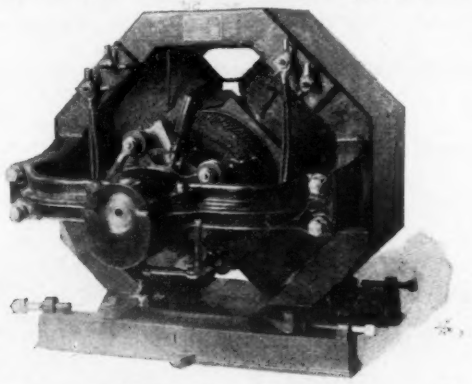
Encouraged by the success of their bipolar dynamos, which they have manufactured for a number of years, Messrs. Roth Bros. & Co., of 30-32 Market Street, Chicago, Ill., have recently designed and placed on the market a line of multipolar generators and motors. These machines embody the latest advances in dynamo construction, and possess a number of special features, as described below.

The armature is of the hollow-drum type, the core being built on a cast-iron hollow cylinder easily removable from the shaft. The core discs, varnished for insulation before being put together, are held between two solid cast-iron end plates, the clamping bolts passing through the inner space of the hollow drum. This method of construction avoids holes through the core discs, thus giving a uniform magnetic path in the armature. The armature coils are wound on a form, wrapped with silk tape, varnished and baked before being placed on the core. The parallel grouping of armature construction is employed, which in connection with a special system of commutator connections greatly facilitates the repair of the armature.

In case a coil has to be removed, this may be done by simply loosening the two armature connectors, of which the coil forms a part, whereas in general, in other four-pole machines, at least one-half, or even all the connectors, have to be unsoldered.

The commutator has a liberal collecting surface as well as wearing stock and a large number of sections. Carbon brushes are used on all machines of 110 volts and over. The brush holders are of the tangential reacting type, the surface on the commutator moving in a direction opposite to the pressure of the springs. Each brush holder contains a number of square carbons, each pressed against the commutator by a spring. The tension of the springs may be adjusted and the carbons removed while the machine is running. These brush holders are among the simplest and most efficient yet devised.

The field frame is of the radical external pole type, which form has met



MULTIPOLAR DYNAMO.

with general approval during late years. The yoke is broad, and entirely protects the field coils. The field cores are annealed wrought iron of circular cross section, which combines a maximum economy in the material and the work of winding the field coils. The bearings are self-oiling, self-aligning and provided with oil gauge and cock.

From the foregoing description it will be seen that great care has been exercised in the design to produce a machine entirely reliable in operation and with all wearing parts interchangeable. The machines are wound either as generators or motors, for 110, 220 and 500 volts, or special voltages. The generators are adapted for lighting, power transmission and electro deposition. When intended for lighting and general distribution they are accurately compounded and are self-regulating at constant speed. The rise of temperature of armature and field coils is well within the limit generally prescribed in dynamo specifications, and in regard to efficiency and operation the machines compare favorably with the best in the market.

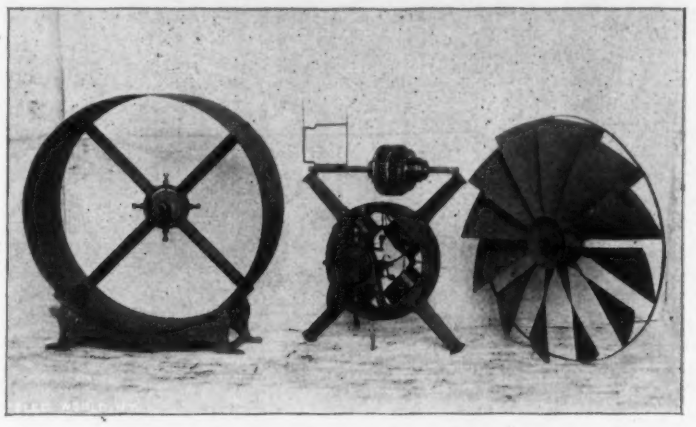
Direct-Connected Motor and Air Fan.

The Fuller & Curtis Company, Detroit, Mich., is placing on the market an air propeller of a design different from anything heretofore used for the expulsion of foul air and gases from buildings.

The advantages of this air propeller over those having the ordinary straight blade are readily seen when the shape of the blade is taken into consideration.

The curve of this blade is a true helix or screw pitch, the line of air propulsion being positive and direct, with none of the back lash common to other fans. In other words, anemometer tests show this fan is handling 35 per cent. more air in cubic feet with the same power applied at the shaft than any other fan placed on the market by ventilator builders. The uniformity of the ventilating wheel is guaranteed from the fact that each blade is made from pressed steel, insuring regularity, not only in shape, but in size. The result is the ventilator expels the maximum amount of air with the minimum amount of whirring. The ventilator is comparatively noiseless in its operation, and is perfectly balanced.

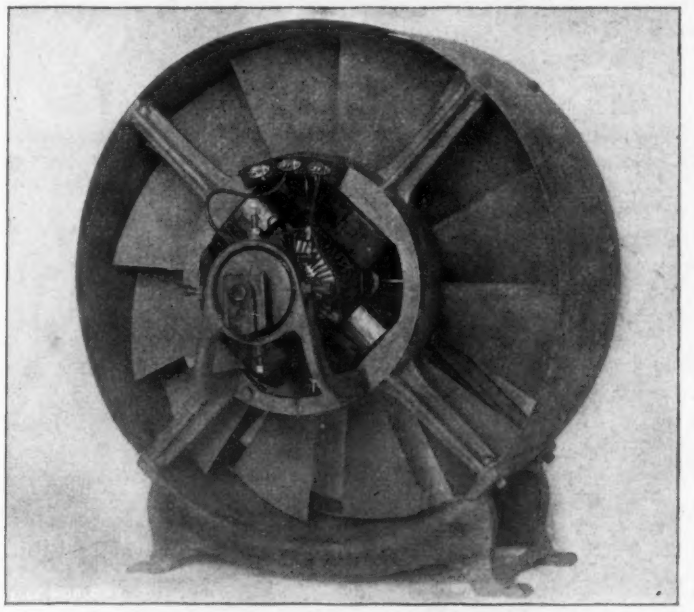
The direct-connected motor is unique in its design and very simple in



PARTS OF VENTILATOR READY FOR ASSEMBLING.

its construction. The efficiency of this motor is high, due to the fact that it has no magnetic break in its field construction. The armature of this motor is made by the best known methods, and is entirely up to date. It is form wound of the Paccinoti slotted type, and is so arranged that the shaft of the fan can at any time be removed from the armature hub or spider without destroying the windings of connections in any manner, the commutator hub being part of the armature spider.

The fans are equipped with self-oiling boxes; these boxes are so arranged



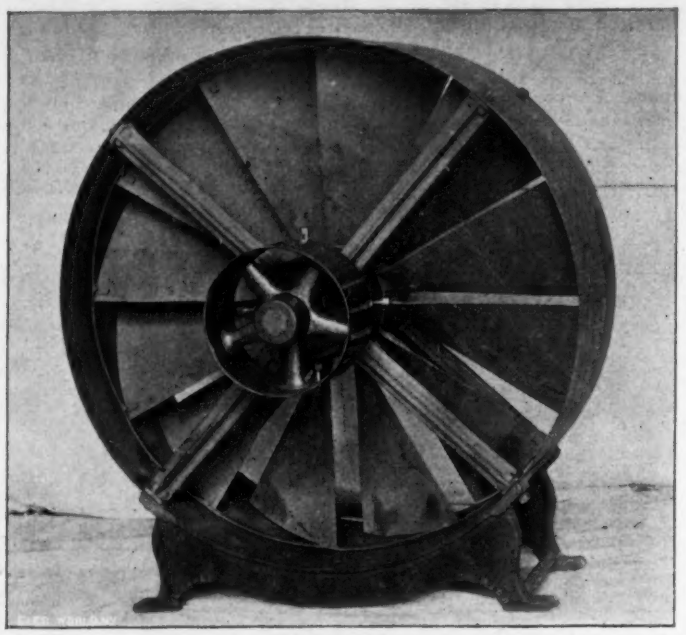
VENTILATOR COMPLETE—1898 PATTERN.

that the fan may be placed in any desired position or at any angle, either on the floor, wall or ceiling. This is accomplished by simply moving the oil box on its axis, so that the oil cellars may be at all times in a vertical position.

The motors are wound for any voltage up to 500. The insulation test of these machines is 2 megohms. Particular attention has been paid to putting a piece of apparatus on the market so designed that one part coincides with its fellow. It may be noticed that in other combinations the fan is

built up by one concern, and the motor attached to the driven piece of apparatus in any manner that will make it go, without regard to symmetry. This combination is not only symmetrical, but considerable space is saved, as the motor does not project beyond the face of the ventilator.

It will also be noticed that all of the motors are of the multipolar type. The fans are built in sizes ranging from 18 inches to 120 inches. The brush holders on the motors are of the improved self-feeding carbon type. The machine requires the minimum of attention, and will run for long periods without the replacing of oil in the oil cellars. All motors are series wound except the large units. In the larger units the various speeds for operating the fan are obtained by commutating the field circuit. In smaller machines up to 60 inches in diameter, a four-speed regulating box is supplied. This box is of the iron-clad type, and so arranged that it will release at any point automatically, should the main line circuit from any cause be opened.



Ventilator for Belted Service.

The direct-connected motors are wound so that the combination can be used to compress as well as exhaust air. The motors do not heat more than 60 degrees F.

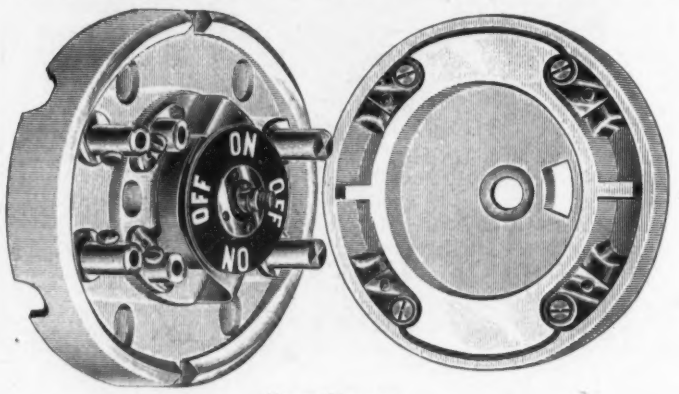
This firm also manufactures the well-known Fuller dynamo and motors, including the double-voltage dynamo.

This company at the present time has equipped forty-seven steamers on the Great Lakes, and several sea-going vessels with its direct-connected engine dynamos and appurtenances.

A New Fuse Switch.

The Perkins Electric Switch Manufacturing Company, Hartford, Conn., is introducing at this time some new and excellent specialties which will undoubtedly receive the same liberal recognition so long accorded to its standard manufactures.

Among these new specialties is the new Perkins fuse switch, which is a combination of a main-line fuse block and a snap switch. It is all porcelain, and furnished as a double-pole, double-fuse switch for 110 volts, and a single pole, three point, and special car-lighting switch with single fuse for 500 volts.



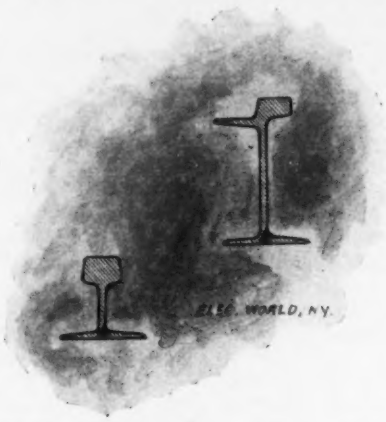
Fuse Switch.

All these switches will open a dead short circuit successfully when not fused above their rated capacity. This is accomplished entirely by means of extra-long fuses, the one in the 500-volt switch being 6 inches long. This will be appreciated by those who have been compelled to replace apparatus each time a fuse blows.

The switch covers, which carry the fuses, are interchangeable, so that the circuit may be closed after a fuse has been blown, by putting on a new cover, which may be had in reserve. The degree to which the wiring and control of a car-lighting circuit can be simplified may be properly illustrated by the use of the special car-lighting fused switch, which will do the work of a fuse block, a single-pole switch, and a three-point or headlight changeable switch. All of these switches are furnished with an indicating dial.

A New Rail Bond.

A complete system of rail bonding has been developed by the Harrington Rail-Bonding Company, 120 Liberty Street, New York City. The bond itself consists of four conductors, varied in size according to the desired capacity of the bond. These conductors are long enough to overreach the fish plates and are terminated in heavy rolled thimbles. These thimbles are rolled to a taper of one-quarter inch to the foot and inserted into a hole drilled and reamed to the same taper, in the foot of the rail just at the base of the web. The hole is drilled at an angle of 60 degrees with the horizontal, giving a surface contact five or six times as large as the cross section of the bond.



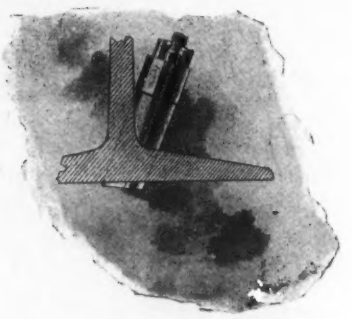
Reamed Holes Showing Large Area of Contact.

After the bond is driven tightly into the rail, the steel of the latter is forced into the copper of the bond thimble by heavy blows on a prick punch. This makes a joint so rigid that the jolting over the rail ends cannot work water into it.

This bond possesses unusual advantages over other types when used in re-bonding. As there is no upsetting to be done on the reverse side of the rail, the street surface has only to be opened on one side. As the drills go down at an angle very close to the head of the rail, the street opening is reduced to a minimum. The factor is taken advantage of in re-bonding elevated tracks, which can be done without removing the guard timbers.

The Harrington Rail Bonding Company has also adopted a complete electrical power drilling and reaming arrangement. The drills are mounted on strong jaws which can be promptly gripped on the rail head. A motor is provided on a wagon with a flexible shaft-driving attachment to four drills which can be operated simultaneously. The design of this apparatus is such as to enable rails to be bonded between cars even with a quite frequent service.

Track Drill and Rail Jaw.



Bond Thimble in Place.

Safety Trolley Wire Hanger.

It has been long desired to cut out the hanging sections on a broken trolley wire, so that they might not come in contact with pedestrians or horses or cause a heavy short-circuit by falling on the track in case of the breakage of the line. The little device illustrated herewith aims to accomplish this end in a novel manner.

The trolley hanger is made with two slots, which, as is readily seen

A SAFETY TROLLEY WIRE HANGER.

from the illustration, engage with pins around which the ends of the sections of the trolley wire from hanger to hanger are folded. By this construction the trolley wire is made sectional instead of continuous and in case of a break between two hangers the broken ends are allowed to fall out of the slots in which they are normally held by their own tension. The device is said to be very quick and satisfactory in its operation. It is the invention of Mr. Isaac Schultes, of Martin, Mich.

Multi-Circuit Arc Dynamo.

The evolution that has taken place during the last few years from the small high-speed belted dynamo to the large low-speed direct-connected unit for incandescent lighting has left the generation of arc-light current in a comparatively very crude state. The arc-light dynamo has, to be sure, gradually increased of late years in size and capacity. As, however, any such increase necessitates a proportional rise in the voltage of the machine, the capacity of the dynamo, as ordinarily constructed, is necessarily limited by the maximum permissible voltage. If the pressure which is certainly fatal to human life is taken for a limit, the ordinary series machine is still far too small for a direct connection to large engines of high steam economy. Any means which are devised for increasing the capacity without increasing the voltage is therefore a notable gain.

Such a means is the multi-circuit arrangement worked out by Mr. S. W. Rushmore, of the Rushmore Dynamo Works, Jersey City, N. J.

The accompanying illustrations show diagrammatically the machine as designed for two independent circuits. The machine is of the ordinary multipolar type, such as used for constant potential work, with the exceptions noted below.

There are in these machines always just twice the number of poles that there are circuits to be supplied. The armature is of the closed-circuit

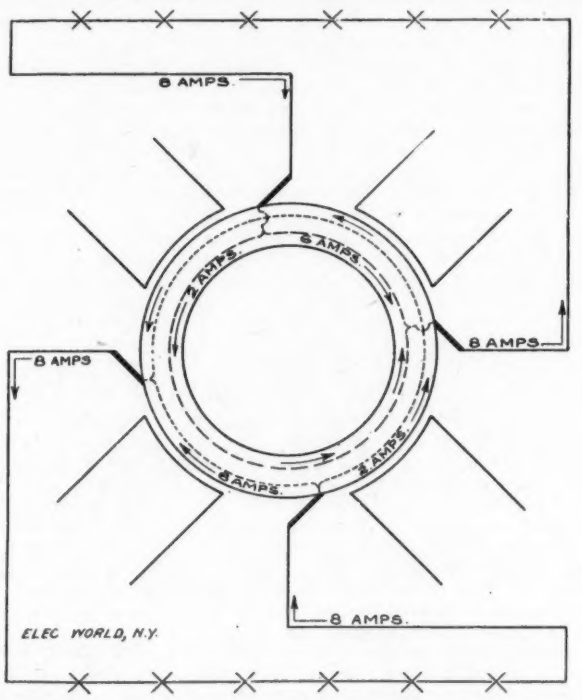


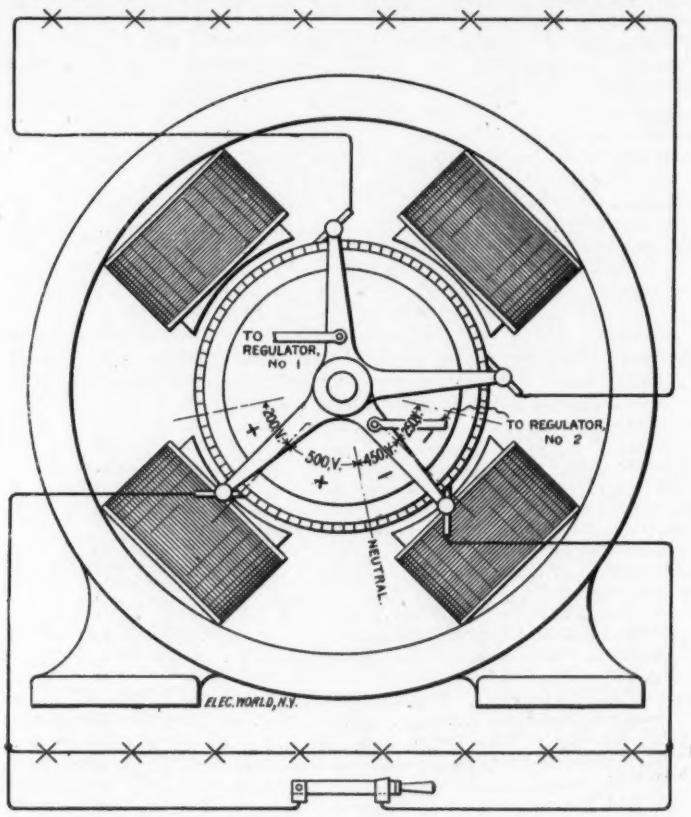
DIAGRAM SHOWING DIVISION OF CURRENTS IN ARMATURE.

single-winding Gramme ring type. Around every alternate pole is mounted a pair of brushes. These brushes are supported on a bell-crank lever as shown, pivoted concentrically with the armature. This lever is free to swing under the control of an electromagnetic current regulator. The method of regulation is by moving the brushes under the pole faces, in that manner obtaining a back E. M. F. sufficient to reduce the pressure as desired. The lower pair of brushes shown in the figure are moved back to points almost centrally located between the neutral points. These brushes are working as indicated on a short-circuited line. The upper pair of brushes is working on full load and is shown in the proper position for such a load, that is, on or near the neutral points of the commutator.

The distribution of the current in this arrangement is quite interesting. It might be thought at first sight that the current entering through one brush would pass immediately under one pole to the opposite brush of the same circuit and thence to the lamps. This would give currents under alternate poles, the other half sections of the armature being entirely idle. This, however, is not the case, as an inspection of the figure showing the current distributions will show. The current entering the armature from any brush divides, part going directly under the pole and part going the other way round under all the other poles. The division is, of course, inversely proportional to the resistance by the two routes, as the E. M. F. around both routes is under normal conditions the same. The division of 8 amperes current, for example, in a four-pole machine would be 6 amperes by the short route and 2 amperes by the long route, as the resistance of the latter is three times that of the former. By laying out these currents under the various poles and obtaining a proper algebraic summation of them it will be noticed that the current distribution is uniform under all poles, as in ordinary constant-potential machines.

A representative of THE ELECTRICAL WORLD witnessed tests on a machine arranged on this principle at the Rushmore Dynamo Works. The machine was only an experimental one, and like most machines of that nature was rather a crude affair. The armature was a second-hand one, fitted to a commutator from another old machine and to fields of still a third machine, and with regulators from still a fourth machine of the arc type. The fields were separately excited. The machine was of the four-pole type, with two independent circuits, and was loaded with 6 arc lamps on each side. The arc lamps were of the shunt-control type, designed only for constant-potential work and quite unsuited for series work. In spite of all these disadvantages the machine showed remarkable results. With both sides fully loaded, one side was abruptly short circuited; the lamps continued to burn steadily on the other side, showing almost entire independence. Both sides were then short circuited and one side abruptly opened; the machine ran on, giving no trouble. With one side carrying full load, the other side was intermittently short circuited and pulled wide open, the lamps burning steadily on the first side. All possible combinations of short circuit, closed and open circuits were tried with ammeters and voltmeters in the circuits. The machine behaved admirably, adjusting itself to the different conditions as rapidly as the regulators could move under the influence of their dash pots.

Such tests seem to show that independent arc-light circuits can be oper-



TWO CIRCUIT DYNAMOS WITH ONE SIDE LOADED AND ONE SIDE LIGHT.

ated from a machine in this manner without in any way mutually interfering with each other's proper action. If further experimenting with a larger and more perfect machine verifies this supposition, the arrangement will make an admirable one for very large units direct connected to large, slow-speed engines similar to the large units now used in lighting and railway work. Such a consummation is greatly to be desired, as the losses, rapid deterioration, and frequent accidents with small, high-speed belted units now in use, are a serious factor in arc-light working.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, September 6, 1897.

ELECTRICAL STOCKS.—There was a decidedly better tone to this market during the last week as compared with that of the week previous, and in practically all cases where changes are recorded prices have advanced. The only exception is Edison Electric Illuminating of New York, which declined 1 point in the bid price. Electric Storage Battery of Philadelphia, both common and preferred issues, showed decided advances, and General Electric, though not quite so strong, closed the week at a figure 1 point higher than the last quotation recorded. The sales of this stock for the week amounted to 40,118 shares, and the fluctuations in price were confined to within 3 points. The highest figure reached was 39½, and the lowest 36⅝, the closing price being 38⅛. The preferred stock is higher.

TELEGRAPH AND TELEPHONE.—Advances are recorded throughout this list, American Bell Telephone showing decided strength and improvement in price. Western Union Telegraph was quite active, the total number of shares sold during the week being 92,278. Quotations fluctuated within 2 points, the highest figure reached being 95¾, and the lowest 93⅛, closing at 95¼, which price is 2⅛ points higher than our last figure.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	121	..
Edison Electric Ill., New York	100	123	125
Edison Electric Ill., Brooklyn	100	115	116
Edison Electric Ill., Boston	100	147	148
Edison Electric Ill , Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	32¾	32⅞
Electric Storage, pref	100	35¼	35¾
General Electric	100	37⅞	38⅛
General Electric, pref.	100	83	87
Westinghouse Consolidated, com	50	21	23
Westinghouse Consolidated, pref	50	55	56
BONDS.			
Edison Electric Ill., New York, con. 5s	105	112⅞	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	100⅛	..
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	255	257
American District Telegraph	100	..	30
American Telegraph and Cable	100	92	95
Central and South American Telegraph	100	124	127
Commercial Cables	100	175	..
Erie Telephone	100	71¼	
New England Telephone	100	104½	105½
Postal Telegraph Cable	100	99	101
Western Union Telegraph	100	95¼	95⅜
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	18⅛	18⅜
Brooklyn Rapid Transit	..	32	32⅜
Brooklyn Traction	100	..	14
Brooklyn Traction pref	100	46	48
Buffalo Street Railway	100	78	80
Cleveland Electric Railway	100	..	..
Columbus Street Railway	100	40	42
Hestonville	100	50½	50¾
Hestonville, pref	..	..	62½
New Orleans Traction	100	6	8
New Orleans Traction, pref	100	25	28
North Shore Traction	100	20	22
North Shore Traction, pref	100	80	83
Rochester Street Railway	..	17	20
Steinway Railway	..	45	50
Union Railway (Huckleberry)	..	102	..
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	99¼	99½
West End, Boston, pref	100	100	100½
Worcester Traction	100	16	18
Worcester Traction, pref	100	90	93
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	88	..
*Buffalo Street Railway 1st con. 5s	100	109	111
Cleveland Electric Railway 1st mtge., 5s	100	102	104
*Columbus Street Railway 1st 5s	100	95	97
Rochester Street Railway 1st 5s	100	90	..
Union Railway (Huckleberry) 1st mtge. 5s	..	107	109
*Westchester Electric 1st mtge. 5s	100	100	103

*With accrued interest.

ELECTRIC TRACTIONS.—There was little activity in these stocks during the past week, and for the most part prices remained practically unchanged. West End in Boston shows a marked increase. Other changed quotations are up and down within narrow margins as compared with the previous figures.

FINANCIAL REPORTS.—The Nassau Electric Company, Brooklyn, reports gross receipts for the year ending June 30 as $1,760,560, an increase of $1,044,618 over the preceding year. An increase of $470,596 in fixed charges and other items reduce the net gain to $14,349. The Buffalo Railway Company, Buffalo, N. Y., reports a decrease of $42,892 in its surplus for the year after the payment of all fixed charges and dividends. The total surplus now amounts to $685,833. The company has declared the regular quarterly dividend of 1 per cent., payable on September 15.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, September 9, 1897.

MR. E. J. WESSELS, general manager of the Standard Air Brake Company, who has been in Europe for the past three months, returned to New York by the steamer "Lucania," which arrived on August 27. Mr. Wessels paved the way for considerable European business.

GEN. T. T. ECKERT.—The New York *Times*, in the illustrated supplement of its Sunday edition of September 5, published a full-page portrait of Gen. Thomas T. Eckert, president of the Western Union Telegraph Company. A full description of his life and life-work was also given as written by Earl D. Berry.

MR. JAMES F. CUMMINGS, president of the Armorite Conduit Company, Pittsburg, Pa., was in town this week. Mr. Cummings stated that among other orders recently received by this company was that just closed with the Union Traction Company, of Philadelphia, Pa., to equip its new power station with "Armorite," the other including 2½-inch conduit for all of the feeders, amounting in all to some 40,000 feet.

RETURNED FROM EUROPE.—Lieut. George O. Squier and Prof. A. C. Crehore, who have been in Europe for some weeks past conducting experiments with their system of telegraphy, arrived in this city on Saturday, September 4, on the Cunard steamer "Etruria." It is stated that these gentlemen obtained during their visit in Europe the uninterrupted use of a wire between St. Petersburg and Berlin, on which the synchronous system of telegraphy invented by themselves, and described in THE ELECTRICAL WORLD some time ago, was tested as to its availability for long-distance service.

MR. EDISON INTERESTED IN WYOMING MINES.—The Salt Lake *Herald* is authority for the statement that Mr. Thomas A. Edison heads a syndicate recently formed to develop the Piney tin mine, which is located 22 miles from Sheridan, Wyo. The company has purchased the mine and has secured in addition 60 other adjacent and surrounding locations. Recent specimens of ore from the Piney mine were tested by Mr. Edison with the result that it was found to be very rich in nickel and platinum. It is stated that improved machinery is now on the way to the mine.

MR. F. R. CHINNOCK, for many years well and favorably known among the electrical fraternity, particularly in and about New York, has recently formed a new company, under the style of the Citizens Electric Construction & Equipment Company, with offices in the Arbuckle Building, Fulton Street, Brooklyn, N. Y. With Mr. Chinnock is associated Mr. D. H. Armstrong, and, as the name of the company implies, its chief effort will be directed toward the complete construction and equipment of electric-light and power plants.

A NEW CABLE ROUTE TO SOUTH AMERICA.—The United States & Hayti Telegraph & Cable Company recently announced its opening for business through to all parts of South America The route of its line, as described in THE ELECTRICAL WORLD of December 12, 1896, is from New York City to Cape Haytien. There it connects with the cables of the French West Indies system, which run to Venezuela, Martinique, French Guiana, Dutch Guiana, to Para, in Brazil. At Para, connection is made with the Brazilian Governmental land lines extending through Brazil and to the system of the Argentine Republic. This route greatly shortens the distance traveled by messages to South American countries. Two routes were formerly available to this business, one via England, Portugal, Madeira Islands and Cape Verde; the other, via Galveston, across the Isthmus, down the west coast of South America, and over the Andes. The reduction in rates averages approximately 25 per cent. The United States & Hayti Telegraph & Cable Company is an American concern.

ELECTRICALLY LIGHTED LIGHTSHIPS.—Two new lightships fitted out with complete electric-light equipments have been received at the Governmental lighthouse yard, Tompkinsville, Staten Island, from the builders, the Bath Iron Works, Bath, Me. These new ships are to be placed, one off Fire Island and the other off Cape Hatteras. They are much larger and more completely equipped than any ships used heretofore. Their dimensions are 112 feet length over all, 28 feet beam and 22 feet depth. They are of composite construction, having steel frames and oak planking, copper-covered. The electrical equipment consists of two direct-connected generating sets furnished by the General Electric Company, and supplying six 100-cp. lamps at the mastheads. The ships are also lighted electrically throughout. Provision is made for flashing the lights by a commutator driven by worm gearing from

the engine shaft. The equipment also includes a complete electrical mechanism for operating the fog whistle, and for recording the time and frequency of its operation. This apparatus is that made by the Signal & Control Company, Brooklyn, N. Y., and was fully described in THE ELECTRICAL WORLD of April 25, 1896. The new ships are fitted with three separate boilers and with propelling engines, and will be manned by a crew of thirteen men. Their first cost was about $70,000 apiece.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Build'ng, 620 Atlantic Ave.,
BOSTON, Mass., September 6, 1897.

RENEWED LAMPS GROWING IN FAVOR.—The lamp-renewing business seems destined to play an important part in the lamp market this fall, as there are increased evidences of a disposition to recognize the repaired lamp. The Lynn Incandescent Lamp Company, of Lynn, Mass., is the oldest and largest of the lamp-renewing companies, and through its success affords abundant evidence that the prejudice against the renewed lamp is being rapidly overcome. Its business continues to show a constant increase, and the best kind of testimony in its behalf is the fact that its first customers are still with it. Mr. E. F. Dwyer, manager of the Lynn Company, ought to feel gratified that his tireless and well-directed energy has brought this company such good results.

THE LEASE OF THE WEST END STREET RAILWAY COMPANY to the Boston Elevated Railway Company for a term of 99 years has now been finally arranged in all its terms, subject to its formal approval by a meeting of stockholders, and goes into operation on October 1 next. This lease transfers to the Elevated Railway Company all the property of the West End Company, including all rights and privileges of that company under the contract of December 7, 1896, with the city of Boston, acting through the Transit Commission. The Elevated Company assumes all liabilities under that contract, and guarantees to the West End stockholders 4 per cent. semi-annually on both the common and preferred stock of that company, in default of which the West End Company may re-enter upon the property. The lease is also subject to the condition that the Elevated Company shall, by January 1, 1898, have $5,000,000 in cash paid in upon its capital stock, and is also, of course, subject to the approval of the Board of Railway Commissioners of Massachusetts.

THE AMERICAN ELECTRIC HEATING CORPORATION says that the recent decision of Judge Putnam of the United States Circuit Court at Boston, referred to in the last issue of THE ELECTRICAL WORLD, will have little if any effect upon its business. As a matter of fact, the devices covered by the patent in suit are no longer manufactured by the American Electric Heating Corporation, and while it is its intention to carry the case to the Appellate Court it does not, and General Manager Ayer says will not, in the event of an ultimate decision in its favor, use in its street-car heaters the device covered by the patent. The facts of the case seem to be that the old American Electric Heating Company was particularly ambitious to control all the patents bearing upon electric heating; that outside of its original numerous patents it acquired many others, notably those of Burton and Dewey, all of which served to strengthen its claims that it possessed the essential and fundamental patents incident to electric heating. There was one car heating company, however, which defied and contested the claims of the old American Company, and in consequence the rivalry and legal contention between the two have been exceedingly lively. Each claimed that the other infringed its patents. When the West End Street Railway Company was in the market for car-heating apparatus, the old American Electric Heating Company was so confident of its position that it agreed to manufacture and supply to the West End road electric heaters of the same type as those made by the other heating company. Naturally under the circumstances suit for infringement followed, and the decision in the first court has been in favor of the other company. The American Electric Heating Corporation succeeded the old American Electric Heating Company and inherited this suit with the other assets. The efforts of the corporation have been assiduously directed toward exploring, to a greater and more diversified extent than any other company the various applications of electric heating, and the success it has met with in what is still a pioneer field has been most gratifying. The Board of Directors include some of the best citizens and business men of Boston, and nearly, if not quite, all of the inherited disagreeable entanglements of the old company have been removed. The American Electric Heating Corporation says the effect of Judge Putnam's decision has been misunderstood, and desires to emphasize that its electric heating system, as installed on numerous street railways, is not of the type used on the cars of the West End road, and that there is no legal controversy of any description with regard to its standard car-heating apparatus, which, Mr. Ayer adds, is giving entire satisfaction wherever used.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., September 6, 1897.

IMPROVED TROLLEY WHEEL.—Oliver Hunt, of North Tonawanda, has invented a trolley wheel that will not leave the wire while the car is in motion. It is claimed that by the introduction of a thread inside of the wheel it is made to stick to the wire on the sharpest curves. An electric supply company in Chicago is negotiating for the purchase of it.

MAY GET THE FRANCHISE.—The prospect of a franchise being given to Mr. George P. Smith by the Common Council of North Tonawanda for the extension of his electric railroad northward is now much improved, as the opposition of taxpayers along the line has largely disappeared. As soon as the franchise is obtained the line will be extended from Buffalo to Niagara Falls.

MEETING OF THE EDISON COMPANIES.—The Edison Association, including the various Edison central station and manufacturing interests, will hold its annual meeting at the Cataract House, Niagara Falls, on September 14, 15 and 16. As in the past it is expected that this meeting will be highly attractive, and the various papers will undoubtedly include many prominent direct-current topics.

THE NEW PHOSPHORUS PLANT.—The new Albright plant for the manufacture of phosphorus, which is situated on the extreme upper end of the tunnel property at the Echota suburb of Niagara Falls, has been started up. It will at present take a 300-hp. current from the tunnel and will employ 25 men. It is expected that the amount of power will be increased before long. The company is an English one, with Mr. Hugh Irvine, of Echota, as manager.

PITTSBURG NOTES.

PITTSBURG, Pa., September 6, 1897.

EXPOSITION OPENED.—Pittsburg's annual exposition, conducted by the Western Pennsylvania Exposition Society, was formally opened on September 1 at the exposition grounds. The mechanical and electrical exhibits are not yet completely in order, but enough has been done to show that they will be well up to the usual standard. The exposition always makes large demands upon the resources of the Allegheny County Light Company. The requirements this year are 140 arc lights of 2000 candle power, and an unusually large amount of alternating current for incandescent lights and power. The alternating current is supplied by one of the four new 1500 kw direct-connected dynamos recently installed by the Allegheny County Light Company, and the first current generated by one of these machines in regular commercial service was utilized in the exposition buildings on the opening night.

A NEW DEVICE FOR SWITCHING TROLLEY CARS.—There has been in service for some weeks at the corner of Wood Street and Fourth Avenue a track-switch operating device that has excited a large amount of public curiosity. Many car lines use the Wood Street tracks, and at busy hours the stream of cars is almost continuous. Some of these cars turn into Fourth Avenue, and some keep straight ahead. Formerly a switch tender was employed at this point to steer the various cars in the right direction. By means of the new device the motorman on an approaching car is enabled to set the switch for himself by a single movement of his controller handle, thus doing away with the services of the switchman. This is accomplished in a very simple manner. About 50 feet from the switch there is placed on the trolley wire, but insulated from it, a copper sleeve 10 or 12 feet long. This sleeve is connected with the feed wire through an electro-magnetic mechanism that throws the switch tongue. This mechanism is placed in a box alongside of the switch, and is so arranged that no matter which way the switch tongue is set, it will be turned the other way whenever a certain amount of current flows through the mechanism. If the switch happens to be set properly for an approaching car, its motorman shuts off his current and allows the car to drift until the trolley wheel has crossed the sleeve on the trolley wire. Thus no current can pass, and the switch remains as it was. If he desires to change the switch the motorman turns on the current while passing under the sleeve, and then all the current taken by the car must pass through the switch-throwing mechanism, and the switch is turned. The scheme seems to work well in practice, and there appears to be little liability for it to get out of order.

CLEVELAND NOTES.

CLEVELAND, Ohio, Sept. 4, 1897.

EXTENSION OF LINE.—Arrangements have just been made to give Warren, O., telephonic connections with Ashtabula, Kingsville and Conneaut.

SMOKING CAR.—A combination baggage and smoking car is now run over the Cleveland, Eastern & Painesville Railway twice a day. The car leaves the Public Square, Cleveland, at 9 A. M. and 4:30 P. M. daily.

WANT FRANCHISE EXTENDED.—The Cleveland, Berea & Elyria Electric Railway Company has just made application to the County Commissioners for an extension from Longview Driving Park on Lorain Street to Linndale.

SALE OF BONDS.—The issue of $10,000 6 per cent. bonds put up for sale last month by the town of Carey, Ohio, for the purpose of constructing an electric light plant, were sold to W. J. Hayes & Sons, Cleveland. This firm gave a premium of $1,026.50.

TELEPHONE IN DOVER.—At a recent meeting of the commissioners of Cuyahoga County, permission was granted to the Cleveland Telephone Company to set poles along the road running north and south through Dover Station, and Dover Centre from the lake road on the north to Dover Centre.

FROM CLEVELAND TO SANDUSKY.—We hear that an electric railway line will be built from Sandusky to Lorain. At Lorain it will connect with the Lorain & Cleveland Electric Railway, making a complete line from Sandusky to Cleveland. The road will be run by way of Huron and Vermillion.

CROSS-TOWN LINE.—It is reported on good authority that a cross-town line is about to be constructed by the Cleveland Electric Railway Company that will parallel the boulevard, and connect Wade and Gordon Parks and Glenville with Lake View and East Cleveland. The new line will be run through to Quincy Street.

POSTAL CAR.—The first postal car to go into use on a suburban electric line west of New England started running last month from Cleveland over the Cleveland & Elyria line. It makes two round trips daily, except Sunday, and will have one railway mail clerk, who will assort and distribute mail along the route. If the project works well the system will be added to the service of all the other suburban lines out of Cleveland.

SALT WELL.—The Cleveland Electric Railway Company is sinking a well at the corner of Central avenue and the Cleveland & Pittsburg tracks, in the hope of finding salt. The railroad at present wastes the exhaust steam from the Cedar avenue power house and the well is being dug to utilize that waste.

The new salt company will not be incorporated under the name of the railroad company, although the road will own the business.

NEW INCORPORATIONS.—The Cleveland Electrical & Telephone Company, of this city, has just been incorporated by J. F. Clark, John L. Caven, Manly Tello, Herbert L. Lilly and Mortan W. Cope. Capital stock, $10,000. The Cleveland Alternating Lamp Company, Cleveland, has just been incorporated by C. Caunter, H. E. Collins, Albert J. Barnes, J. A. Davies and E. M. Barns. Capital stock, $25,000. The company will make electric lamps.

COMPETING LINES.—The Central Union Telephone Company has purchased the county toll lines heretofore operated and owned by the Western Reserve Telephone Company. The Central Union is the name under which the Bell people operate. The Elyria Telephone Company, the Black River Company and the Home Telephone Company, the latter of Cleveland, have a deal on whereby a line will be built to Cleveland, Elyria and Oberlin, and will give free service from here to surrounding towns. They contemplate doing this to compete with the Bell Company.

Chicago Notes.

Branch Office of The Electrical World,
936 Monadnock Building,
Chicago, Ill. Sept. 6, 1897.

MR. WALTER C. McKINLOCK, Chicago, reports trade in his line increasing daily. He has received some large orders for rubber-covered wire and weather-proof line wire. Mr. McKinlock represents one of the largest wire factories in the East.

ELECTRICITY SUBSTITUTED FOR GAS.—Electric lights have been substituted on the Michigan Boulevard for the formerly used gas lights. They were turned on for the first time on September 1. While the improvement was quite marked, the distribution of light was somewhat interfered with by the heavy foliage of the trees on the Boulevard.

MYSENBURG & BADT is the name of a new firm of electrical engineers recently formed by Mr. E. A. Meysenburg and Lieut. F. B. Badt. Both of these gentlemen are well known to the electrical fraternity. The new firm will carry on a business as contractors, engineers and brokers in railway and general electrical supplies, as well as that of consulting engineers, and will act as experts in patent cases. The headquarters of Messrs. Meysenburg & Badt are at 1522 Monadnock Building. Mr. Meysenburg is president of the new concern and Lieutenant Badt secretary and treasurer.

ELECTRIC DELIVERY WAGONS.—Messrs. Charles A. Stevens & Bros., merchants, of this city, have acquired the distinction of being the first business concern to utilize electrically propelled vehicles for the delivery of merchandise. They have contracted for six electric delivery wagons, two of which are already in operation. It is stated that these are the first electric wagons ever used in America for the purpose of delivering merchandise. They are well made throughout, and each one cost $2200. It is stated that they are more easily controlled than it is possible to control a team or a horse.

COMBINATION OF WATER AND LIGHTING PLANTS.—Plans for the extension of municipal lighting are being prepared under the direction of Commissioner McGann. They contemplate the addition of lighting plants to the new Northwest pumping stations. The idea is to use the boilers employed during the day in feeding the pumps to supply the lighting engines at night. In view of the fact that the maximum demand for water is during the daylight hours and the storage of water allows the pumps to be run to a certain extent when desirable, it is thought that this combination will give a very economical load to the station.

Milwaukee Notes.

Milwaukee, Wis., Sept. 6, 1897.

BUSINESS in general is gradually improving. It is very much better than it has been for some time, and there are some very pleasing prospects.

MESSRS. ROHN & MEYER have just completed the erection of two 27-kw Westinghouse multipolar lighting generators. The machines replace 15-kw Edison bipolar machines.

MESSRS. KEELYN & SMITH have the contract to install an electric-light plant at the new coal docks of the Pennsylvania-Ohio Fuel Company at Manitowoc, Wis. A 400-light multipolar generator will be belt-connected to a 50-hp engine, and will furnish current to 100 incandescent lamps and eight inclosed arc lamps. In the near future a motor may be connected, which will consume the balance of the power. The same firm has also installed a 1000-light and a 200-light Card multipolar generator in the Exposition Building to furnish light and power for the building.

Pacific Coast Notes.

San Francisco, Cal., August 27, 1897.

FRANCHISE GRANTED.—The Town Trustees of Berkeley, Cal., have granted a street railway franchise to the Claremont, University & Ferris Street Railway Company.

ELECTRIC POWER IN IRRIGATION WORK.—It has been proposed to utilize Tulare Lake, Kings County, Cal., as a reservoir for irrigation water. The water would be pumped by the use of electric power generated in the Sierras.

TELEPHONE EXTENSIONS.—The Sunset Telephone & Telegraph Company is making rapid progress on the new line from Santa Rosa, Cal., to Fort Bragg. It will ultimately be extended to Eureka, Humboldt County. The Santa Rosa exchange will soon be considerably enlarged. The line from Los Angeles to San Diego, Cal., was recently completed.

THE MERCHANTS' FIRE DISPATCH COMPANY, San Francisco, was recently incorporated by J. A. Marsh, R. H. Swayne, C. L. Tilden, Edward Brown and C. F. Tay. The capitalization is $100,000. Among its objects is to notify merchants and business men immediately upon the breaking out of a fire near their places of business, so that they may be enabled to save their books and papers from possible destruction.

TO KLONDIKE ON ELECTRIC SLEIGHS.—The latest fairy story sent out through the Alaska news factories located in Seattle, Wash., gives details of electric sleighs for winter transportation on the Yukon. They are to be built by the Pullman Company, fitted with upholstered berths and to carry freight and passengers. Some of the sleds, it is alleged, are to be supplied with electric drills to be used for prospecting through the ice in the river beds.

TO SUPPLY ELECTRIC CURRENT FOR MINING OPERATIONS.—The Jordan River Electric Generating Company has closed contracts with several mining companies to supply them with current for operating their mills. Among the points to be reached by the system are La Cigale Mill, Mercur, the Camp Floyd district and Bingham. An electric plant will be installed by the Jordan River company 8 miles from Utah Lake. It is proposed to irrigate 10,000 acres of land from the company's dams.

Southern Notes.

Washington, D. C., Sept 4, 1897.

A CHARTER has been granted to the Spotswood Telephone Company, Staunton, Va., to operate lines in Augusta and Rockbridge Counties.

ENGINEERS ON ELECTRICALLY PROPELLED BOATS.—The following notice has been issued from the office of the Secretary of the Treasury, in regard to steam engineers being required on vessels propelled by electric motors, etc.: "Under the act of Congress, approved June 18, 1897, 'Vessels of above fifteen tons burden, carrying freight or passengers for hire, propelled by gas, fluid, naphtha, or electric motors,' were included in all the provisions of section 4426, R. S. U. S., which requires a licensed engineer and a licensed pilot, the same as is required for steam vessels under said statute. The only qualifications for engineers, provided for in Title LII., R. S. U. S., which includes the statute above noted, are to be found in section 4441 of the same title, and the rules and regulations of the Board of Supervising Inspectors founded thereon; and there is no authority in this department to order a different ruling, as to do so would be contrary to the law and the regulations referred to. This department realizes the difficulties of the situation in regard to gas, fluid, naphtha, and electric motor engineers, and will submit the matter to the Board of Supervising Inspectors when it meets in regular session in January next. In the meantime, and until the board takes action on the subject, the class of vessels under consideration will have to employ a regularly licensed engineer, such as employed on steam vessels."

THE CLAIMS OF THE WESTERN UNION TELEGRAPH COMPANY, aggregating nearly a million dollars, which arose under the régime of ex-Postmaster-General Wanamaker, will soon be reported on by First Assistant Postmaster-General Heath. This claim involves a sum of money estimated, all the way from $600,000 to $1,000,000, and is considered one of the most important cases of the kind ever heard. It involves a question of privilege, which is, whether the Government has the right to force a corporation to accept what it regards as too low a rate for its services. The claim has been pending for some years, and some time will likely elapse before it is finally adjudicated. Mr. Don M. Dickinson had fixed the rate at 1 cent a word for day messages for distances up to 1,000 miles; for distances exceeding 1,000 miles, one-tenth was added to the original cost for each additional 100 miles. For the cipher messages used by the signal services, 3 cents a word was allowed for each word over each circuit. On June 21, 1890, Mr. Wanamaker fixed the rate at 10 cents for ten words for all distances up to 400 miles, and half a cent for each word in excess of ten. From 400 to 1,000 miles the rate was to be 15 cents for the first ten words and three-quarters of a cent for each additional word. From 1,000 miles upward half a cent per word was allowed additional. For night messages he allowed 15 cents for the first twenty words, for all distances, and half a cent per additional word. He reduced the rate for signal-service messages to 2½ cents per word for all messages, and further provided that if any company should reduce its rates to the public below those fixed for the department, the department rule should be changed accordingly. Against the acceptance of this rate the Western Union rebelled. Under the provisions of the statute it could hardly refuse to accept Government telegrams for transmission, nor did it care to lose a business of $200,000 per annum, but it did object to having the rate cut down, especially as it was known that Mr. Wanamaker wanted the rate reduced to 1 mill a word. The telegrams were received under protest and transmitted. For three years the company persistently refused to render any bill to the Government, or accept any pay for its services. In the latter part of the Wanamaker régime a bill was passed by Congress giving the Secretary of Agriculture the right to fix the rate for the signal-service telegrams. As this includes about three-fifths of the telegraph business, the telegraph company felt better when the Weather Bureau restored the old rate. Under Postmaster-General Bissell the rate was raised almost up to its original figures, whereupon the company resumed the presentation of its bills. The bills for the messages sent during the time when the rates were in dispute were presented to the Court of Claims for adjustment, and at the request of the department and the telegraph company the court appointed two referees, one for the company, Mr. William A. Brown, and the other for the department, Mr. C. O. Shepherd, chief of the division of salaries and allowances. For two years the commission dragged along its work. The department had no appropriation out of which it could pay the expenses of the commission, but the Western Union advanced the necessary funds. The conferrees, however, failed to agree on many matters in which they were jointly concerned, friction following. Mr. Shepherd never filed any report, nor did Mr. Brown, until recently. When Mr. Shepherd was relieved from his duties at the department a request was made of the court that some one else be selected in his place, and the Postmaster-General recommended Mr. Heath. The Western Union ad-

vised the court that it was willing that Mr. Heath be made sole referee, which was accordingly arranged. As no report was made by the departmental referee, the matter has to be all sifted again; but a force of men has been put at work, aided very materially by Mr. Brown's report.

CANADIAN NOTES.

OTTAWA, Ont., September 6, 1897.

BIG CARS.—The Ottawa Car Company is at present working on an order for the Hamilton and Grimsby electric road, for two new cars of a novel design, to be 50 feet in length and having baggage and mail compartments. These are said to be the largest electric street railway cars ever manufactured.

THE QUEBEC ELECTRIC RAILWAY.—The capital of the Quebec Electric Street Railway is to be increased from $320,000 to $400,000. The purpose the company has in view in expanding the capital of the railway is to complete and equip the whole line intended to be built, and that it may be finished without delay.

SUBMARINE SEARCHLIGHT TESTED.—At a recent trial on the Ottawa River a new invention, called the submarine searchlight, proved a decided success. The searchlight showed the bed of the river plainly for a circumference of 50 feet, and at a depth of 35 feet objects could be distinguished without any difficulty. The object of the inventor with this light is to enable divers to perform their work with accuracy and to trace lost treasure. It is especally adapted to assist the workers on wrecked vessels lying underneath the water at a great depth. The inventor is Mr. Joseph de l'Etoile, of Ottawa, Ont.

POWER TRANSMISSION ON THE KOOTENAY.—Sir Charles Ross, the Scotch baronet and promoter, is pushing the work on an electric power plant at Middle Falls, on the Kootenay River, 17 miles above Robson. The promoters of this electric scheme expect to have the power house built, dynamos set and wires strung within four months. They will at first furnish power to the Central Star mine. The capacity of the plant will be 10,000 horse-power. The length of the transmission line will be at least 36 miles, or 10 miles greater than the distance from Niagara Falls to Buffalo. An interesting question is involved in this enterprise—its commercial success. Mr. L. B. Stillwell, electrical director of the Niagara Power Company, says the transmission of 1000 horse-power 26 miles is still an experiment, and until he has had actual experience in transmitting a block of 5000 or 10,000 horse power that distance, he has no opinion to express upon its efficiency. The Kootenay promoters seem to take it for granted that they can successfully transmit the 5000 or 10,000 horse-power 36 miles, and make their plant the great generator of electric power West Kootenay.

CANADIANS TO BUILD AN ELECTRIC RAILWAY IN JAMAICA.—One of the largest foreign enterprises that Canadians have undertaken will soon be under way in Jamaica. Mr. W. B. Chapman, of Montreal, has just returned from that island, having secured a charter and franchise from the Jamaica Government to build electric tramways on the island, and it is expected that work of construction will begin within 60 days and continue all winter. Montreal and Halifax (N. S.) capitalists furnish most of the money, and close on to a million dollars will be expended in building the first 25 miles of road in the city of Kingston and suburbs. A large power house will be built on the foreshore, and electric lighting will also be taken up. The conditions are said to be very favorable for electric traction, as in a city of 80,000 inhabitants few think of walking the long distances; and the old street car company, which used mules as a means of locomotion, has earned from 15 to 20 per cent. per annum for the past 20 years. The old company's assets have been purchased by the promoters of the new electric tramway service, who are Messrs. F. S. Pearson, of New York; W. B. Chapman, of Montreal, and B. F. Pearson, of Halifax, N. S. They have now secured a practically perpetual franchise, after a close contest with a Boston (Mass.) syndicate.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, August 25, 1897.

X RAYS.—Great progress is being made with X-rays in this country, as is shown by the fact that at the beginning of the present month the X-Rays Syndicate, Ltd., was registered with a capital of £115,000.

ELECTRIC LIGHT FRANCHISES.—Since the passing of the Electric Lighting Act of 1882 the Board of Trade has granted no less than 384 electric lighting franchises, 49 having been granted during the present year. Of this total of 384 franchises only 284 are still in existence, the others having been revoked. Of the 284 still in existence, 211 belong to local authorities and 73 only to companies. Only 7 franchises survive to-day out of the 73 granted in the year 1883, the year of the memorable electric lighting boom in this country. Of these 7 survivors, all are in a healthy working condition, with the exception of the order granted fourteen years ago to the Greenock Board of Police. It would be interesting to learn how this ancient grant has survived so long without being revoked.

ELECTRICAL COMMUNICATION WITH LIGHTHOUSES AND LIGHTVESSELS.—The Royal Commission on electrical communication with lighthouses and lightvessels, whose investigations have extended over some two or three years, will reassemble early in October for the purpose of receiving a report on the latest experiments. The commission then hopes to proceed forthwith with the consideration of the final report. Since the commission was appointed, experiments have been carried out with cables directly connected in various ways with light vessels; with "discontinuous" cables, with ordinarv "induction" telegraphy, and with Marconi telegraphy. After all this expenditure of time and public money it is hoped that the commission will have something definite to recommend with regard to the electrical connection of our rock lighthouses and outlying lightvessels with the main land.

THE TELEPHONE QUESTION AT GLASGOW.—As your readers may perhaps recollect, the Glasgow Town Council has for several years past been persistently requesting the Postmaster General to grant them a municipal telephone license. A few weeks ago a powerful deputation waited upon the Postmaster General, and he promised that a local inquiry should be held into the complaints made against the service rendered by the National Telephone Company. I believe there was some question at one time of Lord Rayleigh taking part in this inquiry, but apparently something prevented him from doing so, for the appointment is now announced of Mr. Sheriff Jameson. The outcome of the inquiry will be awaited with some interest, as, should it be found that the service at Glasgow is inadequate, inefficient and expensive, it would seem to me that the post office will have no alternative but to undertake the service itself, or to grant a municipal license, and either course will place it in a somewhat awkward position *vis-a-vis* of its staunch friend and ally, the National Telephone Company.

General News.

NEW INCORPORATIONS.

SOUTH WHITLEY ELECTRIC LIGHT COMPANY, South Whitley, Ind., has been incorporated with a capital stock of $4000.

THE ELYRIA GAS & ELECTRIC LIGHT COMPANY, Elyria, Ohio, has been formed by J. C. Hill, N. N. Clough and R. T. Reefy.

THE BIRMINGHAM TRACTION COMPANY, Birmingham, Ala., has been incorporated with a capital stock of $50,000. Those interested are John and Alex. London and G. H. Clark.

THE ST. FRANCIS ELECTRIC LIGHT COMPANY, Forest City, Ark., has been incorporated, with a capital stock of $8,000. The incorporators are P. H. Thompson, D. C. Webb, C. C. White and others.

THE PIN OAK TELEPHONE COMPANY, Dubuque, Iowa, has been incorporated, with a capital stock of $10,000. The directors are J. H. Waldron, Dr. Stuart, J. P. Sweeney, George G. Perry and E. T. Keim.

THE HAVERHILL & SALEM ELECTRIC RAILROAD COMPANY, Haverhill, Mass., has been incorporated with a capital stock of $60,000. Among those interested are W. B. Ferguson, F. E. Lowe, C. E. Barnes and others.

THE SARCOXIE ELECTRIC LIGHT COMPANY, Sarcoxie, Mo., has been formed for the purpose of supplying electric light to Sarcoxie. The incorporators are B. Pile, president; S. H. Hopkins, vice-president, and T. H. Sabert, secretary.

THE CENTRAL TELEGRAPH COMPANY, Cleveland, Ohio, has been incorporated with a capital stock of $100,000. Those interested are J. Howard Van Derveer, Edward A. Klein, Orion F. Thomas, Henry T. Pritchard and La Q. Rawson.

NORTHVILLE TELEPHONE COMPANY, Northville, Mich., has been organized for the purpose of providing telephone facilities for the people of Northville. Among the incorporators are J. M. Burgess, R. M. Johnson, M. A. Porter, F. S. Neal, W. H. Yerkes, A. K. Carpenter, S. E. Cranson, F. M. Warner, G. W. Whipple and F. D. Adams. Capital stock, $1000.

THE TELEGRAPH AND TELEPHONE.

NELSON, MONT.—Local business men are talking of associating together for the purpose of building a telephone line from this place to Grand Forks.

ST. CLAIR, MICH.—The Bell Telephone Company has reduced its rates to 10 cents to Port Huron and 20 cents to Detroit, to meet the rates established by the new State Telephone Company.

NORTHVILLE, MICH.—The new State Telephone Company has completed its line to this point and will continue the construction of the same to Salem. Several farmers along the route will have telephones placed in their homes.

CHATTANOOGA, TENN.—The Southern Railway Company has given an order to the Western Union Telegraph Company to place synchronizing clocks in the stations of all the junctions and principal stopping points on its whole system.

MT. CLEMENS, MICH.—The Bell Telephone Company has again reduced its rates as follows: For business houses, $18; long-distance service, $30; residences, $6. It is stated that the purpose of this reduction is to crush out competition.

DENVER, COL.—The Colorado Telephone Company now has 10,000 miles of wire stretched in this State. The superintendent estimates that some 40,000 people utilize this system daily. The lines extend to Raton, N. M., on the south, Fort Collins on the north, and Aspen on the west.

COLUMBUS, OHIO.—The Ohio Association of Independent Telephone Companies held a meeting in this city on August 26. Seventy-two independent companies in Ohio and Indiana were represented. Routine business and a discussion of plans for the extension of the service were the only matters brought before the meeting.

INDEPENDENT VS. BELL TELEPHONE EXCHANGES.—The following figures represent the relative number of subscribers to the independent and Bell telephone exchanges in the cities named: At Detroit, Mich., independent, 4006; Bell, 2190. At Fort Wayne, Ind., independent, 2405; Bell, 1600. At Grand Rapids, Mich., independent, 2350; Bell, 900. At Lafayette, Ind., independent, 670; Bell, 41.

DOWAGIAC, MICH.—A local paper states that the proposed amalgamation and co-operation of the interstate telephone companies is practically settled, and that it will go into effect on November 1 next. It is proposed to join together all towns in Northern Indiana and Southern Michigan, thus giving telephone service independent of the Bell Company. This will give a long-distance service from Chicago to Detroit, and it will only be a short time before connec-

tions with Ohio towns will be made with independent systems now existing and being constructed.

HOUSTON, TEX.—The local City Board of Appraisement has raised the assessment of the telephone company to $120,000. The board estimates that the business done by the telephone exchange approximates $40,000 per annum.

PULASKI, TENN.—The Giles County Telephone Company was organized here on August 26 to build long-distance telephone lines to operate in connection with the Citizens' Telephone Company of Columbia and the Southern Telephone Company, of Nashville.

MONROE, MICH.—The State Telephone Company has completed its telephone exchange here and made connection with Detroit. The rate to Detroit is only 10 cents, against the Bell Telephone Company's rate of 30 cents. The local annual rates are also reduced in about the same proportion.

CHARLESTON, ILL.—The Interstate Telephone Company has completed its line to Tuscola. The Eastern Illinois Telephone Company has put in a local exchange connecting with its lines eastward. By means of this connection with the Interstate lines communication is rendered possible with over 500 towns and cities in Eastern and Central Illinois. All lines will be operated together as one system and a uniform toll of 25 cents will be charged.

CHICAGO, ILL.—The long-distance telephone lines have been gradually extended out from here toward the West and Southwest. The line to Minneapolis has been completed with ten wires, giving five circuits. The line was formally opened August 31, the Governor of Minnesota and the Mayor of Minneapolis talking with Mayor Harrison of Chicago and Governor Hanna in Springfield. Madison and Eau Claire, Wis., will soon be connected with this line. A line has also been completed to Omaha, but has not yet been formally opened to the public.

COLUMBUS, OHIO.—The State Board of Equalization has rendered a decision that the Bell Telephone Company shall be taxed for its business in this State about $90,000 a year. The company has heretofore escaped taxation by remaining entirely separate from the local companies and simply collecting rentals from them. As there are approximately 25,000 telephones in the State, the Bell Company's income is estimated at $350,000 annually, which, at a tax of 2½ per cent., would yield $90,000 taxes. If back taxes for five years are assessed, a lump sum of $355,000 will have to be paid.

Electric Light and Power.

NORTH VERNON, IND.—The new electric-light plant in this place was formally opened on the evening of August 30.

SILOAM SPRINGS, ARK.—A contract has been closed with a Kansas City firm for building an electric-light system for this city, to cost $27,500.

DETROIT, MICH.—An election will be held September 14 to vote on the question of bonding the city for the purpose of building an electric-light plant.

CHICAGO, ILL.—The West Park Board has decided to extend the electric light plant in Garfield Park. The improvement will involve an expenditure of $60,000.

PALMYRA, N. Y.—The Palmyra Electric Light & Power Company contemplates increasing its equipment, and has issued for the purpose $15,000 of preferred stock.

REMINGTON, IND.—A franchise has been granted by the Town Council in this place to George Fisher to operate an electric-light plant in this town for 10 years. Mr. Fisher will put in a plant with a capacity of 15 arc and 1000 incandescents.

HARTFORD, WIS.—The Common Council has granted Messrs. Rowell & Co. an exclusive franchise to erect and operate an electric-lighting plant in this city for ten years.

MARQUETTE, MICH.—The recent issue of $25,000 in bonds for the improvement of the municipal electric light and power plant has been sold at a premium of over $2,000.

SOUTHFIELD, S. I., N. Y.—The New York & Staten Island Electric Company has been granted a franchise to light the streets of the township of Southfield, on Staten Island.

FITCHBURG, MASS.—The contract for a lighting system for the new Cannon Theatre, which will contain about 1000 electric lights, has been let to the Kimball Electric Company, of this city.

ROCHESTER, N. Y.—A special election has been called in the village of Hammondsport to vote on the proposition of a tax to be levied for the purpose of lighting the streets of the village by electricity.

PITTSBURG, PA.—The local Government authorities have recently had a conference with officers in Washington relative to the establishment of an electric light plant in the Government building here.

ALBANY, N. Y.—Plans are being prepared for a fine office building to be built in this city by Mr. A. V. Benson, 84 and 86 State street. The building will probably be fitted with an isolated plant, elevators, etc.

ROCKAWAY, L. I., N. Y.—The Board of Trustees of the village awarded to Van Wyke & Rositter, of Brooklyn, the contract for lighting the Boulevard, railroad station and public grounds with electric arc lights, to cost $6500.

UTICA, N. Y.—The Utica Electrical & Manufacturing Company has been awarded the contract for a 125-light plant for the first New York beet sugar company in Rome. The work of fulfilling the contract has been commenced.

JERSEY CITY, N. J.—Another theft of live electric-light wire has been committed on the lines of the Hudson Electric Light Company's system. About 2000 feet of arc-light line was made away with on the night of Aug. 31.

BATH, ME.—The Bath Iron Works is to do away entirely with steam for power to run its machinery in all departments, and during next month the necessary motors will be placed in position to furnish sufficient electricity to perform the work.

TIFFIN, OHIO.—Surveyor Charles J. Peters, of Tiffin, and George and Charles Lott, Carroll Heaton and Conrad Rumple are the incorporators of the new electric-light company, with a capital stock of $15,000. The company will at once erect an electric-light plant at Paulding.

PITTSBURG, PA.—One of the four new dynamos of the Allegheny County Light Company was started up on the night of August 30 for the first time. These dynamos are of the Westinghouse make, and are driven by direct-connected Westinghouse engines at 2000 horse-power. Each dynamo is designed to supply 20,000 incandescent lamps.

BROOKLYN, N. Y.—The Amsterdam Electric Light, Heat & Power Company filed a certificate with the Secretary of State to an increase in its capital stock from $500,000 to $1,000,000. The Amsterdam Company proposes, it is stated, to cut the rates that the other companies are charging for electric lighting. The average price per arc per night at present is about 32 cents; the Amsterdam company will charge but 30 cents. The new power station belonging to this company at the foot of South Ninth Street is now completed. Overhead wires are being strung along the Broadway elevated road for current distribution. The increase of capital stock is intended for the building of a new power station near Flatbush. The station will probably be of 6000 horse power capacity.

The Electric Railway.

SHENANDOAH, PA.—A trolley road is to be constructed from Shenandoah to Ringtown that will reduce the rail distance to Ringtown.

WALPOLE, MASS.—The selectmen of Walpole have granted a franchise to the Norfolk Southern Railway Company from Norwood line to Foxboro line.

HUDSON, N. Y.—The Greene County Traction Company has been granted permission by the State Railroad Commission to build its proposed electric railroad.

DEDHAM, MASS.—The selectmen of Dedham have voted to grant the West Roxbury & Roslindale Street Railway Company a location from the Boston line along Bussey Street to East Dedham.

HAVERHILL, MASS.—The Haverhill & Salem Electric Railroad Company has been organized in this city to build an electric railroad from this place to Salem Depot, N. H., during the coming year.

ST. JOHNSBURY, VT.—At a meeting of the stockholders of the St. Johnsbury Electric Street Railway the amendment to the charter passed by the last Legislature for the extension of the road to Lyndonville was accepted.

ALBANY, N. Y.—The Board of Highway Commissioners of the town of Halfmoon last week granted a franchise to A. E. Powers for an electric railway to connect with the Stillwater & Mechanicsville Railroad in Waterford.

COXSACKIE, N. Y.—The State Railroad Commission at Albany, N. Y., has granted the application of the Greene County Traction Company for permission to construct an electric railroad from this place back in the country about 5 miles.

BATTLE CREEK, MICH.—The long-talked-of electric railroad between this city and Gull Lake and Kalamazoo is now assured. The entire right of way has been secured, and it is announced that the contract for grading has been let.

WATSONTOWN, PA.—The promoters are on the ground perfecting plans for the building of a trolley road between this place and Milton and Lewisburg. It is proposed to control all the electric-lighting stations and light the three towns as well.

NEW BRITAIN, CONN.—The New York, New Haven & Hartford Railroad Company has been illuminating its passenger depot in this city by power transmitted over the third rail from its station in Berlin. A storage battery at this end serves to steady the pressure on the lamps.

BUFFALO, N. Y.—The commissioners appointed by the Appellate Division of the Supreme Court to determine whether a street railway line in Utica Street is a public necessity or not, have filed their report. It is to the effect that the line is needed and is a public necessity.

SANDUSKY, OHIO.—It is reported that a syndicate of New York and Boston capitalists has completed arrangements for the purchase of the Sandusky Street Railway line, and it is planned to extend it throughout Northern Ohio. The towns to be reached include Norwalk, Monroeville, Fremont and Clyde.

BIRMINGHAM, ALA.—The Ensley City Railroad, which has heretofore been operated by steam dummy, will be changed to a trolley line. Poles have already been put up, and the wires are being strung. The advantages of electricity for frequent service are well illustrated by the change that will be made on this line from 50-minute to a 20-minute service.

PITTSBURG, PA.—The new Skinner-Dorland electric car brake has been tested on the Avalon division of the United Traction Company, and it is stated has proven satisfactory. The brake is an electromagnetic solenoid arrangement, operating the ordinary brake chain in conjunction with a hand brake. A company has been organized to manufacture the apparatus.

MILWAUKEE, WIS.—The new Fox River Valley Electric Railway line will probably form part of quite an extensive interurban system. A line is now projected between Oshkosh and Menasha, which will probably eventually be continued via Kaukauna to Green Bay. The road will also be extended in all probability to Fond du Lac and eventually to Oconomowic, connecting with the line leading into Milwaukee and Racine.

DETROIT, MICH.—According to the agreement between the Citizens' Company and the local street railway men's association, the company shall not permit any other than union men to run its cars within the city limits, but the Rapid Railway, none of whose employees are members of the association, is permitted to run through the city on the Citizens' Company's tracks.

DETROIT, MICH.—Under the new law permitting electric railways to run freight cars into the cities over their lines during the night, it is possible that

freight cars from Pontiac may soon be seen coming down Woodward avenue. The law went into effect August 29. If one line sets the example other roads will probably do the same thing, in order to give farmers rapid transit for milk and garden truck. The teamsters and truck owners are much exercised over the prospect, and propose to test the right of the railway companies to run these cars. No decision has been reached as yet about running freight cars on the Detroit & Birmingham Railway.

LEGAL NOTES.

TACOMA GAS & ELECTRIC COMPANY.—Judge C. G. Hanford, of the Federal Court, has been asked to appoint a receiver for the Tacoma Gas & Electric Company, of Tacoma, Washington. The application was filed by John H. Shackleford, of Tacoma, representing the New York Security & Trust Company. The bill states that the gas company is indebted to the Trust Company as trustee under a mortgage for $500,000 in the sum of $12,000 interest on the principal note.

DECISION ON SNAP SWITCHES.—In the case of the Hart & Hegeman Manufacturing Company *vs.* Anchor Electric Company, for the infringement of a patent on snap switches, Judge Putnam ordered the dismissal of the action. The decision was based upon the fact that the same presumption exists in favor of the validity of the patent owned by the Anchor Electric Company as of that owned by the Hart & Hegeman Manufacturing Company. "If," says Judge Putnam, "the complainant has any remedy, it is not in the courts, but in convincing the purchasing public that the device of the respondents is less simple, economical and compact than its own."

PERSONAL NOTES.

MR. THOMAS F. ATTIX, of Brooklyn, left for Glenwood Springs, Colo., last month on a pleasure trip, and expects to return about the 15th of the current month.

MR. F. P. FISH, the counsel of the American Bell Telephone Company and of the General Electric Company, who has been ill in New York with typhoid fever, is convalescent, and has gone to Swampscott, Mass., to recuperate.

AN APPEAL FOR AID.—It will no doubt come as a painful shock to the friends and acquaintances of the late Harvey L. Lufkin to learn that by his death his widow, a most estimable lady, has lost her sole support, and, what is more, has been left without any source of income whatever. She has therefore at the solicitation of friends consented to make her distressful condition known to the friends of her husband, and to ask for aid to enable her tide over her temporary difficulties. A committee has been formed to undertake the collection of funds for her benefit, and Mr. James W. Godfrey, 15 Cortlandt Street, New York, has kindly consented to act as treasurer. It is earnestly hoped that this appeal will meet with a prompt response, and the committee would impress upon contributors the fact that any contribution, however limited, will be welcome. The case is an urgent one.

OBITUARY NOTE.

MR. GEORGE STEWART HEGEMAN, a member of the firm of Hart & Hegeman, Hartford, Conn., died suddenly at Detroit, Mich., on September 4, of pneumonia. Mr. Hegeman was 39 years of age. His remains were buried at Passaic, N. J., where he had been spending the summer. Mr. Hegeman was unmarried.

Trade and Industrial Notes.

EXTENSION OF FACTORY.—Messrs. Aylsworth & Jackson, manufacturers of fluoroscopes and X-ray apparatus, are building an addition to their factory at 128 Essex Avenue, Orange, N. J.

LARGE WATER WHEEL BUSINESS.—The Stilwell-Bierce & Smith-Vaile Company, Dayton, Ohio, has unfinished orders ahead for water wheels with an aggregate capacity of 125,000 horse-power.

GOOD FOREIGN DEMAND FOR TELEPHONES.—The Missouri Telephone Manufacturing Company, St. Louis, has found a great demand from foreign countries for its products, receiving daily numerous inquiries from abroad. It recently made quite a large shipment to Honolulu and to Mexico.

LARGE CALL FOR RHEOSTATS.—The American Rheostat Company, Milwaukee, Wis., finds its business increasing to such an extent that it has to run its shops night and day. This in spite of the fact that it has recently added a new equipment of machinery and increased its facilities in order to keep up with its orders.

THE PHILADELPHIA GAS IMPROVEMENT COMPANY, of Philadelphia, Pa., is increasing its plant by erecting a new fireproof pipe shop, constructed entirely of iron. The building has steel framework and a corrugated iron covering. Contract for erecting the building has been let to the Berlin Iron Bridge Company, of East Berlin, Conn.

MESSRS. ROHN & MEYER, Milwaukee, Wis., have recently closed the following isolated plant contracts: Espenhein Co., and Blatz Hotel, Milwaukee; one complete isolated plant for the Holy Family Convent, Manitowoc, Wis.; also Westinghouse generators for the West Bend Lighting Company, of Wisconsin. Mr. Jacob Cloos is the consulting engineer for the above plants.

THE MAINE ELECTRIC COMPANY, Portland, Me., is meeting with marked success with its electric hoists, many of which are now in use for unloading ships. This company is about to place upon the market a gravity electric elevator controller, which it claims will supersede the magnetic controller now in use and which it also claims will operate with 25 per cent. less power than present controllers require.

LARGE STOCK OF PORCELAIN SUPPLIES.—The Electric Appliance Company is well pleased with the experiment of carrying in stock in Chicago a line of porcelain in all styles and sizes of knobs and tubes, that will enable it to fill any order. The advantage of having this stock in Chicago instead of having to go to the factories for this material seems to be appreciated by the trade, and the Electric Appliance Company is reaping very satisfactory results. It is the Chicago depot for one of the largest porcelain works in the country, and claims to carry a much larger and better assortment of stock of porcelain than has ever been carried in Chicago before.

AFTER SOUTHERN BUSINESS.—The Standard Underground Cable Company announces that it has opened an office in rooms 1225-1226, Betz Building, Philadelphia, Pa., and placed it in charge of Mr. T. E. Hughes, formerly New York manager of the company's wire department. Mr. Hughes will give his entire attention to the trade in the Southern Atlantic States, and the company assures its friends and patrons that their business will receive careful and prompt attention at his hands. By the aid of a special long-distance telephone connection the Philadelphia office will be able to forward orders to headquarters at Pittsburg without any delay, and the home office will be thus enabled to execute such orders with promptness.

"THE CONSTRUCTION OF THE INCANDESCENT LAMP."—A very attractive little booklet has been issued by Messrs. Machado & Roller, New York, giving the story of the construction of the incandescent lamp, with illustrations of the lamp factory of the Allgemeine Elektricitats Gesellschaft, Berlin, Germany. Illustrations showing the different steps in the manufacture of lamps of this class are artistically executed and the language used in the descriptive matter is very entertaining. Any one unfamiliar with the work of making incandescent lamps will find it both profitable and deeply interesting to read this little work. Messrs. Machado & Roller are sending copies out to the trade. It is stated that the Allgemeine Company is the largest manufacturers of incandescent lamps in the world.

MR. F. W. BUNTS, formerly assistant secretary and treasurer of the Walker Company, Cleveland, Ohio, has bought the business of the Cuyahoga Supply Company, dealer in electric street railway and lighting supplies, and general selling agent in Cleveland and Northern Ohio, for Eugene Munsell & Co. and the Mica Insulator Company. Mr. Bunts will continue the business under the same title as formerly, occupying the offices at 102 Superior Street. He is a young man who has a large acquaintance in the city of Cleveland and vicinity, and his association with the electrical trade will, no doubt, bring to his company a large business. His leading lines, to which he will devote his special attention, will be the "Micanite" specialties, as manufactured by the Mica Insulator Company, of New York, Chicago and London, and Eugene Munsell & Co.'s India and amber mica in all its various forms.

ENLARGING ITS FACTORY.—The new lines of multipolar slow-speed generators and motors and enclosed ironclad motors which the C & C Electric Company, of New York, has placed upon the market within the last 60 days, have met with such great favor upon the part of engineers, manufacturers and other users of this class of apparatus, that this company has found even its present large and excellent factory equipment inadequate to promptly turn out the many machines of these and other types for which it has orders. It has consequently found it necessary not only to increase its force and working hours, but as well to purchase new machinery. The C & C Company feels much gratified over the pronounced success these new types of machines have met with, also over the fact that there is still, as has been for several years, a steady demand for its well-known bipolar motors and dynamos.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

VISITORS TO LINCOLN PARK IN CHICAGO will be delighted with the souvenir book of this beautiful spot, now being distributed by the Chicago, Milwaukee & St. Paul Railway Company. It is a magnificent publication of 96 pages, full to overflowing with delicious half-tone pictures of one of Creation's most charming places of resort for citizens of the great republic. No stranger visiting Chicago should be without a copy of the "Souvenir of Lincoln Park." It can only be procured by enclosing twenty-five (25) cents, in coin or postage stamps, to Geo. H. Heafford, general passenger agent, 410 Old Colony Building, Chicago, Ill.

Illustrated Record of Electrical Patents.

UNITED STATES PATENT ISSUED AUGUST 28, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

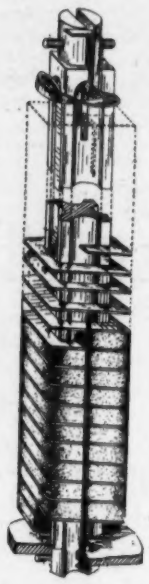
588,923. TROLLEY WIRE HANGER; G. E. Johnson, Los Angeles, Cal. App. filed June 5, 1896. As a means for attaching a trolley wire to a trolley-supporting wire, a connection in which the frame is made of one piece with a suitable insulator for preventing the current from the trolley wire from passing onto the trolley-wire-supporting wire, and suitable screws for fastening the connection to both the trolley wire and the trolley-wire-supporting wire.

UNITED STATES PATENTS ISSUED AUGUST 31, 1897.

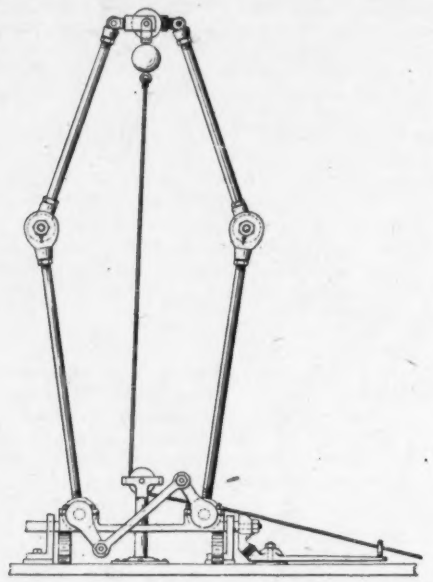
588,942. FIRE ALARM; J. W. Arnold, Otsego, Mich. App. filed April 29, 1897. A fire alarm comprising the following essential elements, to wit: a tower, a bell mounted therein, a bell clapper, a disc wheel provided with pins adapted to actuate the clapper, a gear wheel for rotating the disc wheel, a pulley secured on the shaft of the gear wheel, a winding drum, a rope wound about said winding drum and passed over a pulley and provided with a weight moving in vertical guides, a gear wheel secured on the drum shaft, a shaft, a pinion on said shaft in mesh with the wheel, an escapement wheel on said shaft, a second shaft, a ratchet wheel and a pinion on said shaft, a wheel journaled below said shaft and engaging said pinion and provided with an arm, a pivoted lever having a toe engaging said escapement wheel and having its other end held by said arm against movement, a spring rod having a toe that engages the wheel, an electro-magnet, the armature of which is provided with a rod that holds a second rod with its dog in engagement with the wheel.

588,965. MUNICIPAL SIGNAL SYSTEM; H. F. Eaton, Cambridge, Mass. App. filed Nov. 24, 1888, renewed Feb. 1, 1897. In a municipal telegraph system comprising a central station and several sub-stations connected by an electric circuit, a multiple-signal transmitter at each sub-station, constructed and arranged to transmit a series of impulses constituting the sub-station number and adapted at times to transmit another long series of short, successive impulses, combined with a register to receive the signals transmitted by said transmitters, and a special indicating device unaffected by one of the series of impulses, but affected by the long series of short successive impulses.

588,997. ELECTRIC ALARM AND CALL BELL; F. C. Jordan, Wadsworth, Ohio, App. filed Jan. 11, 1897. The combination with a clock, having its hour-hand in connection with one pole of a battery, of contact-fingers adapted to make connection with said hour hand, and connected with a switch-board; a series of contact plates severally connected with said switchboard, and one post of a series of bells; the other posts of said bells connected with the opposite pole of the battery; and sliding plates to simultaneously connect said contact plates, to cause all of said bells to ring by the contact of said hour hand and any of said fingers.



No 589.042.—STORAGE BATTERY.



No. 589.109.—TROLLEY.

588,999. ELECTRIC METER; E. J. King, Fort Wayne, Indiana. App. filed May 1, 1897. In an electric meter comprising field coils and a plurality of movable coils secured at an angle to each other upon a common axis within the field, connections for energizing the coils and means for measuring the resulting torque.

589,015. ELECTRICAL BODY APPLIANCE; J. P. McGill, Chicago, Ill. App. filed Feb. 23, 1897. A flexible battery belt comprising a plurality of continuously arranged galvanic or voltaic couples, insulation between the adjacent couples, and flexible connections between the couples and insulation.

589,042. STORAGE BATTERY; W. J. Still, Toronto, Canada. App. filed Feb. 10, 1896. In a storage battery, an electrode comprising a rectangular continuous hollow spiral of flat strip sheet lead in flexible form, with both edges free and interposed hollow spiral of active material exposed at the inside and outside, and a supporting post for the electrode extending up within the spiral and forming a guide for the free lengthwise movement of the spiral.

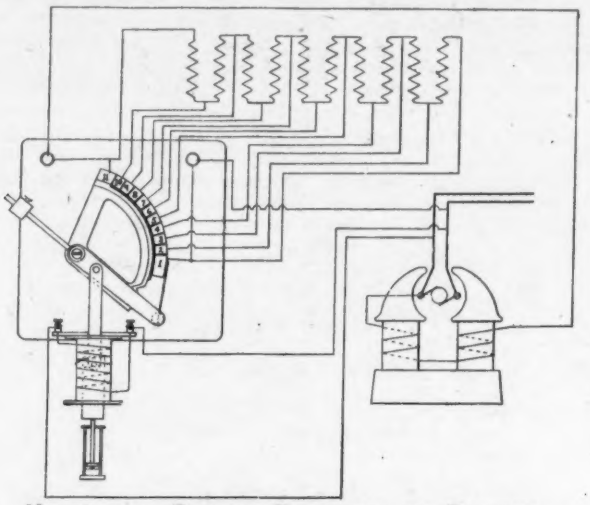
589,073. ELECTRIC REGULATOR FOR DYNAMOS; W. H. Chapman, Portland, Me. App. filed April 4, 1896. The combination with a dynamo having a shunt winding on its field magnet, a rheostat connected in circuit with said shunt winding, a solenoid electrically connected with the terminals of said dynamo and having a movable iron core arranged and adapted by its magnetic force to operate the arm and slider of said rheostat—an adjustable retarding device consisting of a cylinder, a piston and piston rod, said piston rod being attached to said core at one end, and at the other end being threaded to receive the piston and having a passage through it which the piston is arranged to close or open according as it is screwed to different positions along the rod.

589,109. TROLLEY; A. B. Wyman, Turner's Falls, Mass. App. filed April 20, 1897. A support for the trolley wheel of trolley cars, consisting of a frame which is pivotally supported longitudinally thereof on the top of a car, said frame being provided at each end with springs which bear on the top of the car, and with shafts which are mounted transversely thereof, said shafts being provided at one end with cranks, which are connected by a crank rod, and said shafts being also provided with upwardly directed main arms, which connect at their upper ends with a tubular cross head, and provided with a shaft which passes therethrough, said tubular cross heads being also provided each with an upwardly directed supplemental arm, and said shafts in said tubular cross heads being provided with springs which operate upon the main arms and on the supplemental arms, and said supplemental arms being pivotally connected at their upper ends with a cross head in which is mounted a trolley wheel, and means for depressing said trolley wheel and operating said frame.

589,112. ELECTRIC CAR-LIGHTING SYSTEM; F. M. Bennett, New York, N. Y. App. filed Jan. 4, 1897. The combination, with a vehicle, of a dynamo actuated by the movement of the vehicle, of a secondary battery, and of a switch for directing the current to the secondary battery, consisting of an armature, controlled by the field of the dynamo.

589,115. OUTLET BOX FOR GAS PIPES AND ELECTRICAL CONDUITS; W. J. Billings and M. Mauer, New York, N. Y. App. filed June 7, 1897. An outlet box for gas pipes and electrical conduits provided with removable and interchangeable sides, and a removable and interchangeable bottom plate.

589,128. AUTOMATIC SWITCH FOR CHARGING OR DISCHARGING SECONDARY BATTERIES; A. S. Hubbard, New York, N. Y. App. filed Oct. 25, 1896. In an automatic charging switch for storage batteries, the combination of a charging circuit and a working circuit, two sets of storage batteries, connections between the charging and working circuits and said batteries, a switch for alternating the connections between the storage batteries and the charging and working circuits, held out of operation by a magnet in the charging circuit, whereby the circuit connections are changed upon the cessation of the charging current.



No. 589,073.—ELECTRIC REGULATOR FOR DYNAMOS.

589,162. BRUSH FOR DYNAMOS; F. J. Chaplin, Birmingham, England. App. filed March 17, 1897. The improvement in brushes for dynamos, consisting of one or more sheets having the wires running diagonally, and one or more sheets having the wires running square with the length and breadth of the brush and with a wire centre.

589,170. RAILWAY SIGNAL; C. W. Grant, Concord, Mass. App. filed Nov. 19, 1896. The combination in a railway signaling system of a series of coils located along a section of railway and having their terminals connected to the track rails of a neighboring section, a generator on the train for energizing the said coils by induction, and a receiving coil carried by the same train in proximity to the said series of track coils, and connected with signal-receiving apparatus on the train.

589,186. MEANS FOR OPERATING GENERATORS AND STORAGE BATTERIES IN CONJUNCTION; W. Meredith and A. M. Hunt, San Francisco, Cal. App. filed Sept. 8, 1896. The combination of an auxiliary dynamo, storage battery, and main dynamo, the armature of the auxiliary dynamo and the storage battery being connected in series, and the two being in shunt with the main dynamo, the auxiliary dynamo having two independent field windings magnetically opposed, one being in series with the external circuit of the main dynamo, and the other in shunt with any source of approximately constant potential difference.

589,256. PROCESS OF MAKING INSULATING MATERIAL; J. Gray and C. H. Case, South Manchester, Conn. App. filed May 16, 1896. The improved process of making an insulating material consisting in forming a mass of pulp to shape, heating the same in a bath of molten sulphur, and subsequently setting such article by immersion in a cold bath.

589,347. ELECTRIC PIANO; J. L. Fulkerson, Kansas City, Mo. App. filed Dec. 4, 1896. In an electrically operated piano, a transmitting key provided with a wire extending longitudinally thereof, a contact point at the front end of the key extending downward, a contact plate arranged beneath said contact point, and a spring arranged at the rear end of the key and electrically connecting the longitudinal wire of the key and the circuit-wire, whereby the circuit is normally broken but adapted to be completed when the key is depressed.